APPLIED Hydraulics & Pneumatics

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NCIH

National Conference on Industrial Hydraulics

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THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

. . . read each month by 26,000 men who apply fluid power products to all types of machines and equipment

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AIJ

Wherever 2-way shut-off is required...

HERE'S THE COUPLING FOR THE JOB

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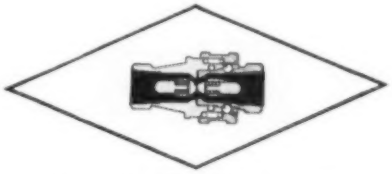
SERIES HK®

TWO-WAY SHUT-OFF COUPLING

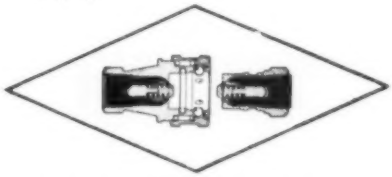
shuts off both sides of line... prevents loss of liquid, gas, or pressure



QUICK-CONNECTION *with* INSTANT AUTOMATIC FLOW

To connect Coupling, merely pull back sleeve, push Plug into Socket.

Blue section shows how torpedo type valves open in both Socket and Plug to permit free flow of gas or liquid through connected Coupling.



QUICK-DISCONNECTION *with* INSTANT AUTOMATIC SHUT-OFF

To disconnect Coupling, just pull back sleeve on Socket. No tools required.

Blue section shows how torpedo type valves contact valve seats in both Socket and Plug to provide instant seal of fluid in both ends of line.

WRITE FOR THE HANSEN CATALOG

Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for L.P. Gas, Steam, Oxygen, Acetylene, etc.

To connect a Hansen Two-Way Shut-Off Coupling, you merely pull back the sleeve and push the Plug into the Socket. To disconnect, just pull back the sleeve. No tools required. When Coupling is disconnected, similar valves in Socket and Plug shut off both ends of line—practically eliminate spilling of liquid or escape of gas at instant of disconnection.

Hansen Series HK Two-Way Shut-Off Couplings are available with female pipe thread connections from ⅛" to 1" inclusive. Available in brass or steel.

SINCE 1915 — QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

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NEW HYDRAULIC FLOW CONTROL VALVE

Calibrated for Precision Control

3/8" VALVE
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$16.00

HANNA *Flo-Set 1000* VALVES

are used for controlling flow of petroleum liquids, water and synthetic hydraulic fluids.
Pressure to 1000 psi.
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Temperatures –40° F to +250° F

To meet the demands for precision control of hydraulically powered equipment, Hanna offers this new calibrated speed control valve. Flow can be accurately regulated from zero to desired rate by turning the adjusting sleeve. Once set to the desired flow rate the valve can be "locked". Calibrations assist in setting the valve to pre-determined flow rates.

The new Flo-Set 1000 Valves are the result of over 50 years of Hanna design and manufacturing experience in the field of fluid power. They are built to close tolerances with quality materials and like all Hanna products they are offered only after extensive laboratory testing and field experience. Their performance is guaranteed for the service specified.

Ask your Hanna Representative listed in your classified directory and Thomas' Register for complete information—or write us for details.

Hanna Engineering Works

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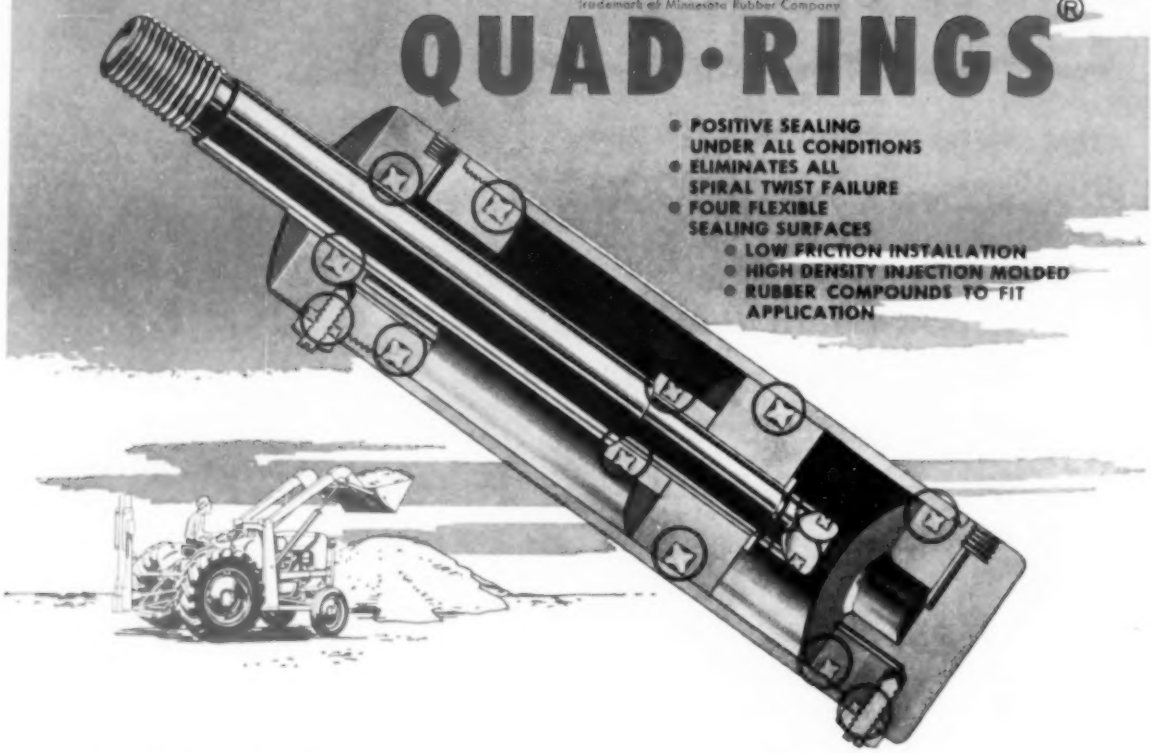
- ELIMINATES ALL SPIRAL TWIST FAILURE
- FOUR FLEXIBLE SEALING SURFACES
- LOW FRICTION INSTALLATION
- HIGH DENSITY INJECTION MOLDED
- RUBBER COMPOUNDS TO FIT APPLICATION



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The MR QUAD-RING gives superior sealing in reciprocating, rotary, and static applications at pressures ranging from 0 on up.

ELIMINATES ALL SPIRAL TWIST FAILURE—This costly cause of O-ring failure is eliminated because the relatively square cross-section of the QUAD-RING will not roll.

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HIGH DENSITY INJECTION MOLDED—All QUAD-RINGS are molded by MR's exclusive injection molding process to give an exceedingly dense product. There are no voids to cause seal failure.

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MR compounds are designed to give the best possible service, using basic polymers such as natural or synthetic rubber, silicone or any other that will perform best under the specific conditions.

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Hydraulics & Pneumatics

OCTOBER 1958

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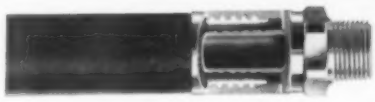
ANDY ANCHOR SAYS:

WE CAN SUPPLY THE RIGHT HOSE ASSEMBLY



Anchor Ductile Sleeve Couplings for high pressure assemblies incorporate a ductile sleeve which virtually makes the coupling a part of the reinforcing wires of the hose. Used on 2-Wire Braid, Extra Strength 2-Wire Braid, 3 and 4-Wire Braid Hose. Sizes available from ¼" I.D. 3-Wire Braid, 7000 PSI Max. Wk. Pres. to 2" I.D. 2-Wire-Braid, 1125 PSI Max. Wk. Pres.

Anchor Medium and Low Pressure Assemblies, for 1-Wire Braid Hose with a working pressure of 3000 PSI in the 3/16" I.D. size to 375 PSI for the 2" I.D. size, have an integral insert and an internally threaded shell that provide a permanently tight grip on the hose. "O" Ring Seals between swivel nuts and coupling bodies prevent leakage. Also available in Max-Flo design for greater flow capacity and in Style QW (1-Wire Braid Cotton Covered Hose) and QWR (Thin Rubber Covered Hose).

Anchor Max-Flo HI-BURST 2-Rayon Braid Hose Assemblies for medium and low pressure have couplings with integral inserts that are internally expanded as the threaded coupling shell is swaged, thus providing a positive grip. The I.D. of the coupling is substantially the same as that of the hose providing maximum flow capacity from 1250 PSI to 375 PSI Max. Wk. Pres. Available in ¼" to 1¼" I.D. Hose.

Anchor Low Pressure 2-Rayon Braid Hose Assemblies and Anchor Low Pressure Multi-Purpose Hose Assemblies are designed for maximum working pressures of 500 to 625 PSI and 200 to 250 PSI respectively. Both are made with hex brass couplings.

Anchor Max-Flo Suction Hydraulic Return Line Assemblies are made with spring steel reinforcing wire interwoven with cotton cord to produce a non-collapsible hose. Modified dovetailed locking grip on inner shell of the coupling, and barbed integral insert provide a tight grip. Available from ¾" I.D., 300 PSI Max. Wk. Pres. to 2½" I.D., 65 PSI Max. Wk. Pres.

Anchor Pressed On Ductile Sleeve "O" Ring Flange Head Couplings, for use with Anchor 4-Bolt Split-Flange halves, utilize the same tested and proved hose gripping methods used on other Anchor assemblies. Couplings are available in straight, 22½°, 30°, 45°, 60°, 67½° and 90° angles in standard and in a 360° swivel coupling. For standard and extra strength 2-Wire Braid Hose and 3-Wire Braid Hose from ½" to 2" I.D. and from 900 PSI to 3500 PSI Max. Wk. Pres. Also for Spiral Wire Suction Hose ¾" to 3" I.D., 300 to 55 PSI Max. Wk. Pres.

ANCHOR ADAPTER UNIONS AND PIPE FITTINGS

Anchor precision-made Adapter Unions, designed for use with Anchor Pressed On and Reusable Couplings, prevent hose strains and twisting and eliminate one or more pipe thread joints.

For complete specifications on Anchor Pressed On Hose Assemblies, write for Anchor Catalog No. 101. Anchor's SAE Boss Fittings described in Anchor Catalog No. 204. Anchor Flanco, 4-Bolt, Split Flange Couplings and Assemblies are described in Catalog No. 402. Please request specific catalog desired.

PRESSED ON

In the selection of hose assemblies, one of the most important factors is length of service. Anchor Pressed On Hose Assemblies are competitively priced, but their outstanding feature is the long dependable service they render. This is the result of Anchor's insistence on highest quality in material and workmanship through every manufacturing step. Experience will prove that you can always depend on Anchor for maximum service life!

SPLIT-FLANGE HYDRAULIC HOSE ASSEMBLIES . . . featuring the Anchor Flanco, 4-Bolt, Split-Flange "O" Ring Head Couplings are described in Anchor Catalog No. 402. They are available in Pressed On style for original equipment installations — Clamp Type, for immediate repairs or special assembly installations, and Weld Type, for connecting pipe or tubing to system components having an SAE 4-bolt port boss, or for pipe to pipe connections. Widely used for high, medium and low pressure hydraulic, and for suction return applications. Anchor Flanco, 4-Bolt, Split-Flange "O" Ring Head Couplings meet SAE standard requirements shown on Page 808, 1957 SAE Handbook. Anchor Catalog No. 402 may be had by writing to Anchor Coupling Co. Inc., 306 North Fourth Street, Libertyville, Illinois.

LPG HOSE ASSEMBLIES . . . with Pressed On, Reusable and Clamp Type Couplings are described in Anchor Catalog No. 500. The Pressed On type assembly is available in three hose styles: 1-Wire Braid, Style LPW, for 350 lb. working pressure, 2-Rayon Braid, Style LP, for 350 lb. working pressure and Anchor LP51 Hose for 250 lb. working

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386 North Fourth St., Libertyville, Ill.

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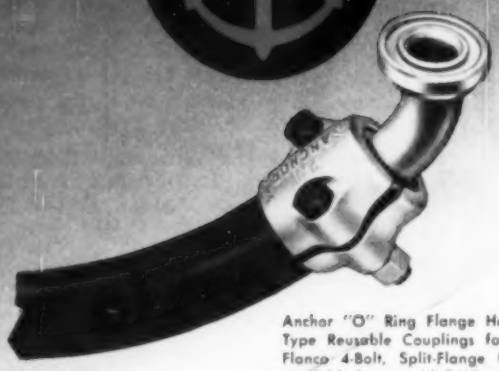
Pressed on or Reusable...

ANCHOR HAS BOTH



REUSABLE

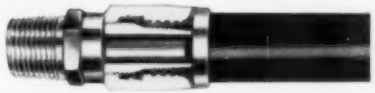
Anchor Reusable Couplings are designed for a wide variety of hose styles to suit virtually any hydraulic, LPG or Anhydrous Ammonia need. They are all similar in their easy, free installation, making them ideal for quick, emergency repair. The long, trouble-free service they render is the result of Anchor's rigid quality control system under which all Anchor products are manufactured. Whatever your hose requirements, Anchor can fill them efficiently and economically.

Anchor "O" Ring Flange Head Clamp Type Reusable Couplings for use with Flanco 4-Bolt, Split-Flange Halves are available for use with 2-Wire Braid Hose, Extra Strength 2-Wire Braid Hose, 1-Wire Braid Hose, Spiral Wire Suction Hose and Medium Pressure HI-BURST 2-Rayon Braid Hose. "O" Ring Head Clamp Type Coupling Stems, for use with Clamp Type Reusable Couplings are available in standard angles from 0° to 90° in sizes from ½" to 3" I.D.

ANCHOR SAE STRAIGHT THREAD "O" RING BOSS ADAPTERS

Designed for use with new SAE Boss, they insure positive leak-proof connections without excessive tightening and thread distortion. Now supplied with factory applied back up washer that prevents "O" Ring extrusion.

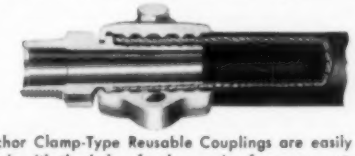
For complete specifications and engineering data on Anchor Reusable Couplings, write for Catalog No. 302. Anchor Adapter Unions and Pipe Fittings are covered in Catalog No. 204.



Anchor High Pressure Reusable Couplings for 2 and 1-Wire Braid Hose require no special tools or replacement parts for attachment to hose. Emergency repairs are completed on the job with minimum down time. Couplings are streamlined and have a threaded insert and shell that provides a positive, leak proof grip. Available for ¼" to 1" I.D. 2-Wire Braid Hose, working pressures from 5000 PSI to 1875 PSI, and ¼" to ¾" I.D. 1-Wire Braid Hose, working pressures from 2750 PSI to 1250 PSI.

Anchor "Duloc" Reusable Couplings for medium and low pressure, Style QW 1-Wire Braid Cotton Covered Hose, and Style QWR with thin rubber cover over cotton braid, are streamlined and easy to assemble in confined spaces. The Anchor Hex Drive Assembly Mandrel makes attachment easy. Duloc Couplings are made for 3/16" to 1-13/16" I.D. Hose for 3000 PSI to 350 PSI Max. Wk. Pres.

Anchor HI-BURST 2-Rayon Braid Hose Assemblies with Reusable Couplings are made in sizes ¼" to ¾" I.D. for working pressures from 1250 PSI to 750 PSI Couplings require no special tools for attachment and no skiving of hose cover and have a firm, blow-off proof grip. Standard 2-Rayon Braid Hose Assemblies with similar Reusable Couplings are available in ½" and ¾" I.D. for 625 and 500 PSI working pressures.



Anchor Clamp-Type Reusable Couplings are easily applied, with the help of only a pair of common automotive wrenches. They are excellent for emergency repairs and experimental plumbing of equipment. Available for following types and sizes of hose for high, medium and low pressure: 2-Wire and 3-Wire Braid High Pressure and 1-Wire Braid Medium Pressure Hose from ¼" I.D. to 2" I.D. Also available for Spiral Wire Suction Hose from ¾" to 2" I.D. and HI-BURST 2-Rayon Braid Hose from ½" to 1" I.D.

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CIRCLE 11 ON TIME-SAVER CARD

pressure. Style LPG carries UL approval and has rayon braid reinforcement. Also described in this catalog is a new Dual Pressed On or Reusable Hose Assembly, designed for use on LPG Service Trucks, that consists of two standard hose assemblies joined by neoprene covered aluminum clips. Lighter weight and replacement of a single hose at a time are advantages offered. For use on loading docks, for connection to tank cars and transfer trucks, is a new hose assembly with a 3½" Acme Thread, offering a lighter weight connection. Ask for Catalog No. 500. Anchor Coupling Co. Inc., 306 North Fourth St., Libertyville, Ill.

AUTOMOTIVE, AIR AND FREON HOSE ASSEMBLIES . . . A wide selection of low pressure, synthetic hose assemblies with Pressed On Couplings, suitable for use with gasoline, oil, diesel fuel, air, water, grease, kerosene and common hydraulic fluids, is presented in Anchor Catalog No. 601. Also described are special tube-hose combination assemblies, such as are used for power steering, and a complete range of Freon 12 assemblies. A copy of this catalog may be had by writing to Anchor Coupling Co. Inc., 306 North Fourth St., Libertyville, Ill.

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- Greater wear resistance
- Tighter sealing
- Temperature stability

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If you seal oil, water, air, vacuum, gas, gasoline, naptha, alcohol or other fluids, ask MARSH for field engineering service, immediately available to you for the job you are designing, tooling, manufacturing.

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. . . Fluid Power news

REPORT NO. 11,701 SERVO-CONTROLLED MOBILE DRILLING BARGE

From Oilgear Application-Engineering* Files

HOW OILGEAR Æ* SOLVED THE "CONTROL AND MUSCLE" PROBLEMS ON MR. GUS II

OWNER: C. G. Glasscock Drilling Co., Corpus Christi, Texas
(Built by Bethlehem Steel Company Shipbuilding Division, Beaumont, Texas)

DATA: System design and equipment for a 9,000-ton mobile oil drilling barge. Barge platform is large enough for 28 bowling alleys on each of its three decks (173′ x 104′ x 22½′) — allowing ample room for spectators . . . will accommodate personnel and all equipment for complete offshore drilling operation.

REQUIREMENTS: 1: Operation to be selected from central control room: (1a) remote automatic, (1b) remote semi-automatic, (1c) manually controlled at each station. 2: Accurate, automatic synchronization and visual indication during lifting and lowering operations to insure keeping platform level. 3: Power selection and control from remote control room for: (a) four anchor winches, (b) four 10′ dia. by 235′ long caissons which raise the platform up to 50′ above the surface of water 150′ deep. 4: Individual, local control for: (a) moving drilling derrick bridge to and from drilling position, (b) driving four 7′ dia. by 130′ long steel pilings 40′ to 65′ into Gulf bottom. 5: Must be quiet, dependable, vibration and trouble-free.

LEFT: Mr. Gus II operating in 137 ft of water. With full equipment as shown, "Gus" grosses over 9,000 tons. At previous location in 80-ft water depth, "Gus" was undamaged by hurricanes Bertha and Esther. **ABOVE:** Operational "nerve" center for Fluid Powered operations. Oilgear servocontrolled indicators above the Oilgear control console show positions of each of four caisson jacking-yokes within ±⅛". Control panel of console is shown in insert. These controls can be used for complete automatic, semi-automatic, or individual control.

SOLUTION: An Oilgear Application-Engineered *electro-feed-back-hydraulic-servocontrol and indication system*, built by The Servocontrol Division of Oilgear, for accurate remote and local control over the Oilgear Application-Engineered Fluid Power systems. Automatic synchronization during lifting and lowering — by electrical comparison and compensation is so accurate that if platform tilt exceeds 1/30th of a degree of arc, operation shuts down automatically. Two Oilgear Heavy-Duty "Power-Paks" using type "DY," two-way, variable displacement pumps with servo-motor and hydraulic amplifier controls power each of the four caissons and anchor winches. Compact, plug-in, hand pendant, servocontrols are provided for local, manual operation. Two heavy-duty "Power-Paks" using type "DH," two-way, variable displacement pumps with servo-motor lever control inside each caisson smoothly drive the steel pilings, "locking" the barge to the Gulf bottom. The drilling derrick is moved from drilling to transport position by a similar pair of "Power-Paks" with type "DH" pumps.

OWNER REPORTS — *"In addition to setting a world record as far as water depth location, Mr. Gus II performed satisfactorily in setting the well protective structure — something that no other rig in the world can attempt to do . . . the most outstanding offshore rig yet designed and built . . . no trouble at all with the equipment you (Oilgear) built . . . you have certainly created a fine piece of machinery."*

A detailed, 12-page operating description of Mr. Gus II is available from Oilgear. Request Fluid Power News 6.

The large drilling barge "S-66" being built by Avondale Marine Ways, Inc., New Orleans, La., will be similarly Oilgear-equipped . . . as will "Mr. Louis I," a huge, 12-caisson drilling barge being built by Universal Drilling Co., Inc.

Other Oilgear marine applications include power and control systems for steering and flanking gear, elevators, catapults, hoists, winches, large valve controls, lock and dam gates.

Users in ALL industry agree that . . .
. . . for the lowest cost per year — it's Oilgear!

For similar practical solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Controlled Motion Systems
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ACCO
Helicoid Gage
U.S.A.

NOTHING BUT THE BEST IN GAGES FOR WORKING PRESSURES FROM 30" VACUUM TO 10,000 p. s. i.

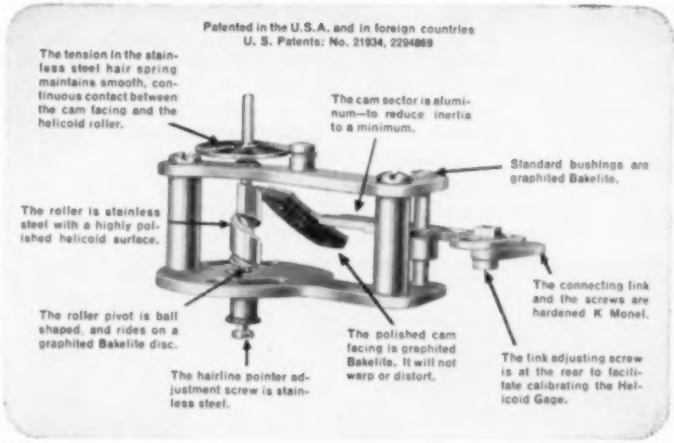
Shock-Proof Cam Actuation (no gears—no teeth) Makes Helicoid Gages Ideal for Hydraulic Services

Designed for pulsating and impact hydraulic service, the Helicoid movement releases at zero in the event of sudden pressure reduction. This eliminates shock on pointer and movement by reducing impact of pointer against pointer stop pin. This protects the gage mechanism where gages may be subject to occasional vacuum.

The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or certain severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21934, 2294869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

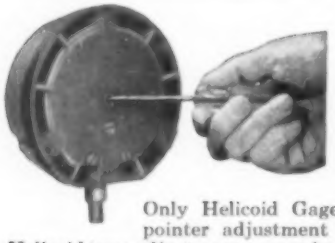
HELICOID GAGE CARTRIDGE SNUBBER

(Patent pending)

This is a simple, effective throttling device to reduce or eliminate pulsations of the gage pointer. There are no moving parts, no adjustments needed. Available in three types in powdered bronze or stainless steel for air, gas, water, steam, medium or heavy liquids.

Enlarged cutaway view

Threaded cartridge body for assembly in any Helicoid Gage tapped socket shank



EASIEST ADJUSTMENT AND CALIBRATION

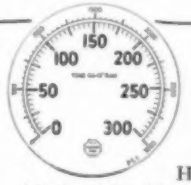
Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

TUBES BUILT FOR MILLIONS OF PRESSURE PULSATIONS

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak nor crack.



DOUBLE SCALE DIAL SHOWS TONS ON RAM AND PSI

Helicoid Gage dials are supplied in jet black with white figure markings or in dull white with black figure markings. They are constructed of laminated phenol with a transparent plastic surface and the longest possible scale length for more accurate readings. They are non-corroding, will not discolor nor fade and will not crack, chip nor peel.

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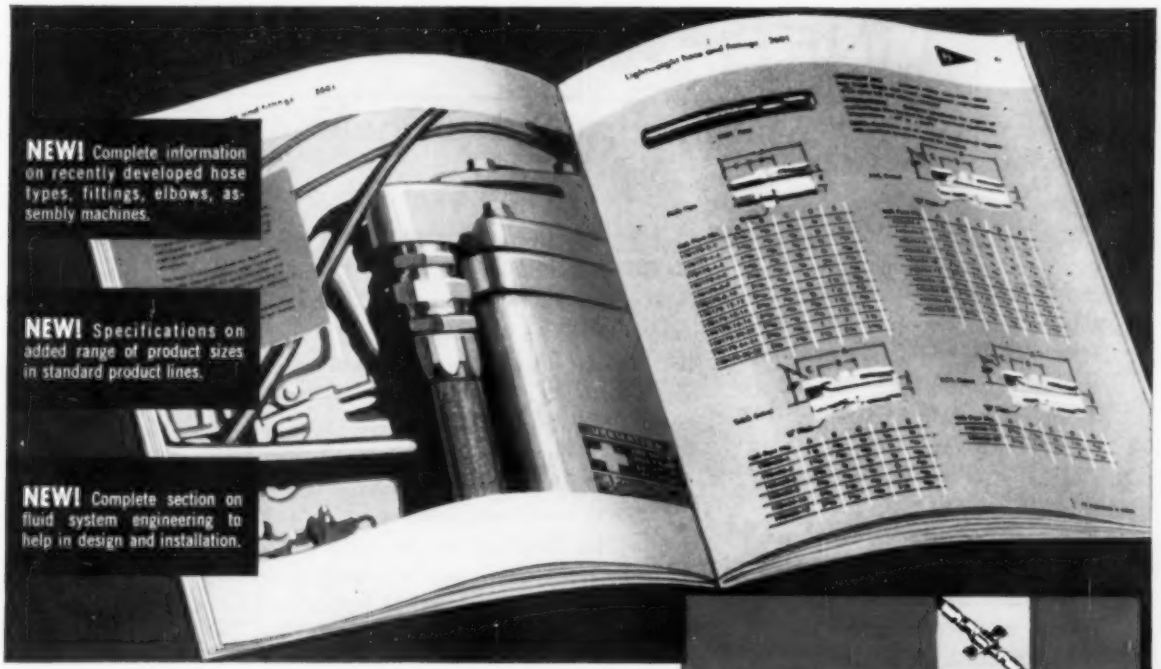
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CIRCLE 4 ON TIME-SAVER CARD

FLUID POWER LINES

about hydraulics & pneumatics

THE BIG PAY-OFF . . . At the National Conference on Industrial Hydraulics, in Chicago on October 16 and 17, $1200 in awards will be presented by APPLIED HYDRAULICS & PNEUMATICS to winners in the annual Prize Paper Contest. The purpose of APPLIED HYDRAULICS & PNEUMATICS in sponsoring this contest is to stimulate an interchange of design ideas in the growing field of fluid power, and to recognize the outstanding work of men who are making the developments.

For the sixth year, entries have shown a wide range of hydraulic and pneumatic applications in the areas of industrial production machines, mobile equipment, and aircraft. Basic ideas explained in these papers will be valuable to engineers in all fields where fluid power is applied.

Thanks and compliments go to all those who entered the contest. Their papers reflected the many hours they spent in developing the equipment they described. All prize winning papers, and those receiving honorable mention, will be published in AH & P during the coming months.

H. CUTLER, PAUL BOSEN . . . Combining their talents in this year's top prize paper, Hy and Paul also combine their experience in designing hydraulic and electrical control systems for machine tools, pharmaceutical and packaging equipment made by Snyder Tool & Engineering. Now a control engineer, Hy had varied experience in drafting and machine design before he received his BSEE degree from Wayne University. He started his industrial experience in 1941, and continued it in service as a draftsman in a railroad outfit. Paul has been working with circuits since 1951 when he received electronics training in the Navy. He continued this at the Electronics Institute of Detroit where he completed courses in radio and television engineering.

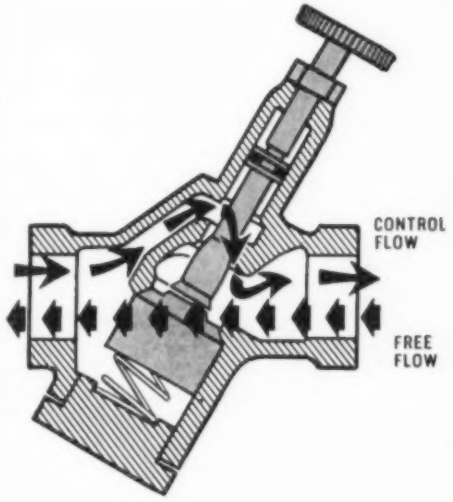
EUGENE T. RAYMOND, JOHN W. HULL . . . The University of Washington takes credit for the education of both these men who co-authored the second-prize paper on aircraft leakage control. Gene has been in the Mechanical Equipment Unit of Boeing Airplane Co. since 1946. He has conducted several research programs in hydraulics and related systems, and is now lead engineer of a research group in high temperature hydraulics, high pressure pneumatics, and accessory power systems. John, who is also in Boeing's Mechanical Equipment Unit, has conducted several hydraulic system test programs and is now developing high-temperature, high-pressure gas actuation systems and components.

KENNETH KNAPTON . . . Third-prize winner, Ken Knapton brings outstanding experience to his position as Product Manager of Hydraulics at Sanders Associates, Inc. A graduate of Tufts, he has completed several graduate courses in control system design and analysis. He's had responsibility in designing both pneumatic and hydraulic control systems for test facilities. He now coordinates engineering, production and marketing of his company's line of aircraft and industrial electrohydraulic servo valves and complete control systems.

Tranquilize your cylinders

Rx

Ross speed control valves

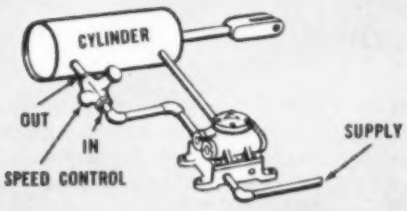


FREE FLOW TO CYLINDER (LEFT)
CONTROLLED FLOW FROM CYLINDER

PRICED WITH THE LOWEST

By keeping full power driving the cylinder but metering the flow from it, you can get smooth, positive and infinitely variable control of the cylinder speed without the problems that come with trying to adjust cylinder movement by varying inlet pressure. This is why speed control valves are so satisfactory for making cylinders act right. And why do so many specify Ross speed controls?

Simply this. When you turn the adjustment screw things don't "just happen." Instead, you force the air to flow through a carefully engineered variable orifice, an orifice designed to create fine shadings of control at both high and low flow rates. And, this performance is yours in a valve that is designed and built to thrive under rough conditions and still be around for a long time. This valve's only moving internal part is its poppet. You can lock its adjustment against tampering. It mounts in any position. Its aluminum alloy body gives heavyweight performance with welterweight bulk. Join the thousands who profit by using Ross speed control valves.



The speed control valve as used between a 4 way valve and a cylinder, shown above, regulates (slows down) the piston rod retraction.

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ALUMINUM ALLOY BODY

BUBBLE TIGHT POPPET

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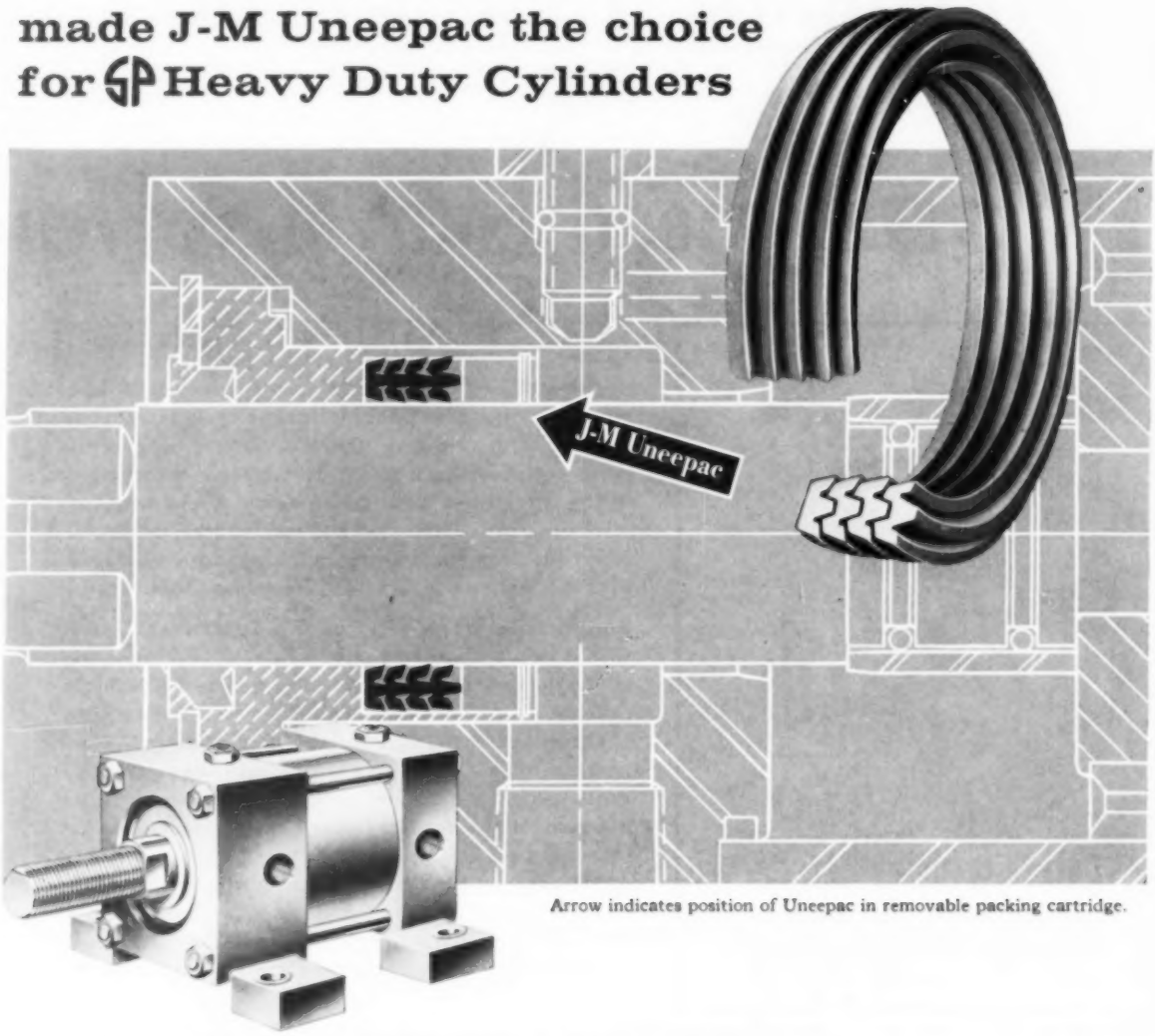
made J-M Uneepac the choice for S-P Heavy Duty Cylinders



Arrow indicates position of Uneepac in removable packing cartridge.

Automatic ring packing helps solve design problem for the S-P Manufacturing Corporation of Solon, Ohio

THE INCREASING TREND toward automation in industrial processes has been made possible by the development of dependable service-free equipment like S-P Heavy Duty Cylinders. Among the design features which make S-P Cylinders so reliable are two Johns-Manville precision moulded packings.

J-M UNEEPAC® automatic ring packing provides maximum sealing in minimum space because each ring is a complete packing unit. This permits an overall reduction of the cylinder size and, in particular, enables S-P to include a quick-change removable packing cartridge. Uneepac is also self-adjusting—each ring positions itself automatically on adjoining rings. Friction is low because when assembled in sets, fluid pressure acts upon each lip individually. Lip section is also well supported to prevent distortion under pressure.

J-M U-CUPS are also used in the S-P Cylinder as piston head packing. They are precision-made for easy assembly, accurate fit, efficient sealing, reduced friction and long life.

Uneepac and U-Cups are made in a variety of compositions for a wide range of hydraulic and pneumatic applications. For further information, write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

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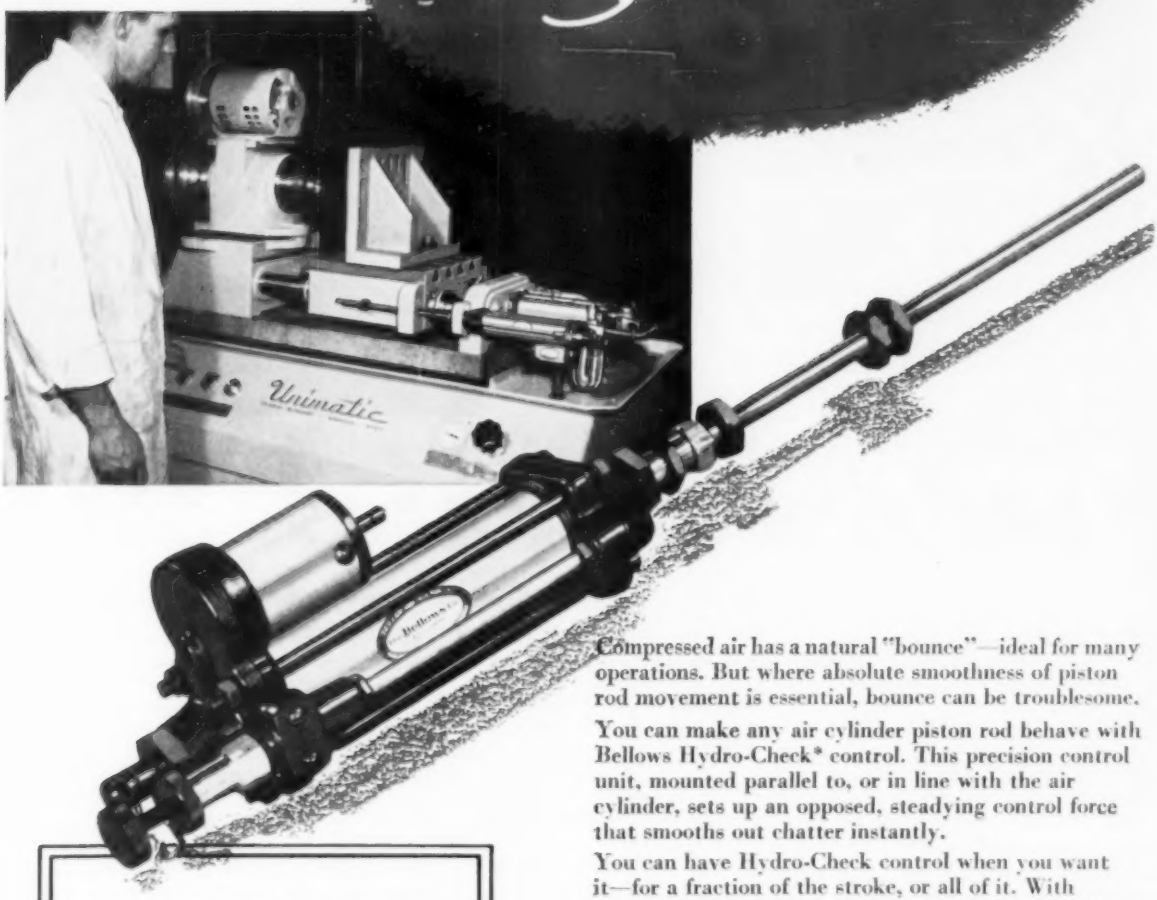
JOHNS-MANVILLE JM PRODUCTS

CIRCLE 74 ON TIME-SAVER CARD

how to give any air cylinder...

Hydraulic Smoothness



Compressed air has a natural "bounce"—ideal for many operations. But where absolute smoothness of piston rod movement is essential, bounce can be troublesome.

You can make any air cylinder piston rod behave with Bellows Hydro-Check* control. This precision control unit, mounted parallel to, or in line with the air cylinder, sets up an opposed, steadying control force that smooths out chatter instantly.

You can have Hydro-Check control when you want it—for a fraction of the stroke, or all of it. With certain models of Hydro-Checks you can have "Skip"—or intermittent checking action; or you can stop an air cylinder piston at any point in its travel for a predetermined time and then resume traverse. Hydraulic control can be on either advance or retract strokes or on both.

*T.M.Reg.

If you use air cylinders in precision operations, you'll want to know more about Bellows Hydro-Checks—precision hydraulic control for air cylinder power. Write for Bulletin HC-602 Address: The Bellows Co. Dept. AH-1058 Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd. 14 Advance Rd., Toronto, Ont.

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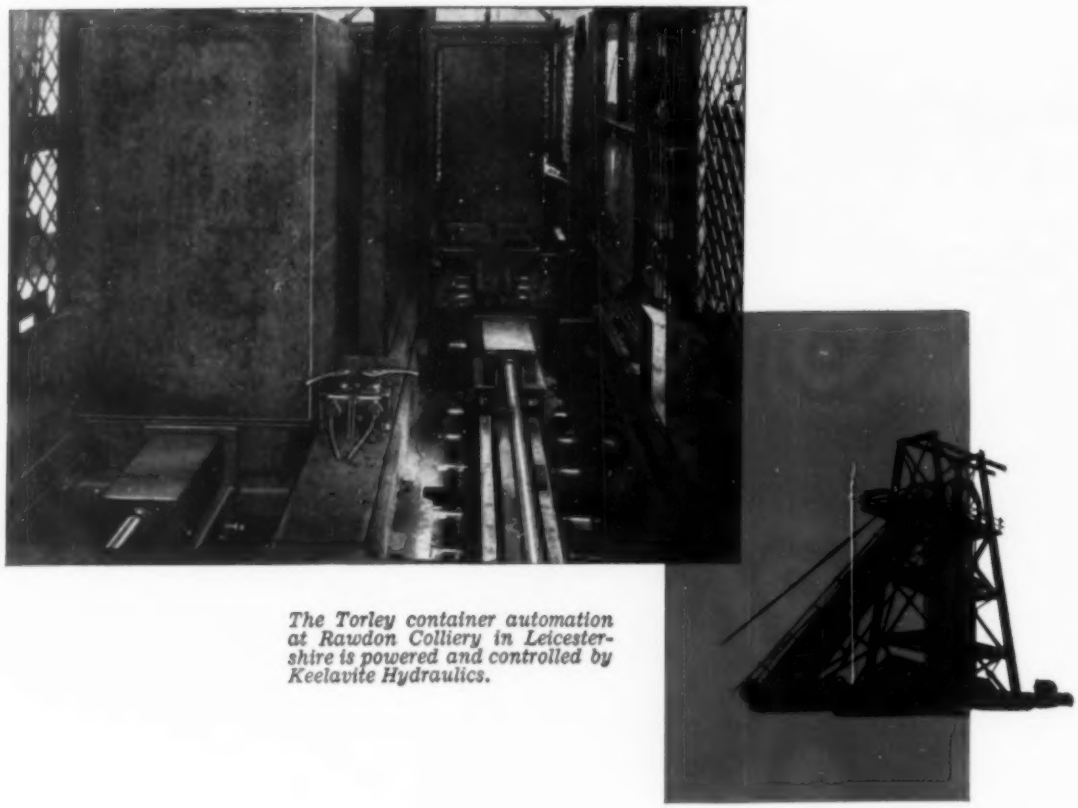
CIRCLE 21 ON TIME-SAVER CARD



The Torley container automation at Rawdon Colliery in Leicestershire is powered and controlled by Keelavite Hydraulics.

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We at Keelavite are a team of experts in the design, installation and maintenance of complete hydraulic systems. We are ready to accept full responsibility for the proper working of all our installations, including all electrical or other control equipment.

Not only this, we are the manufacturers of the largest range of hydraulic units in the United Kingdom.

We are, of course, fully experienced in special applications of hydraulic power for the mining industry.

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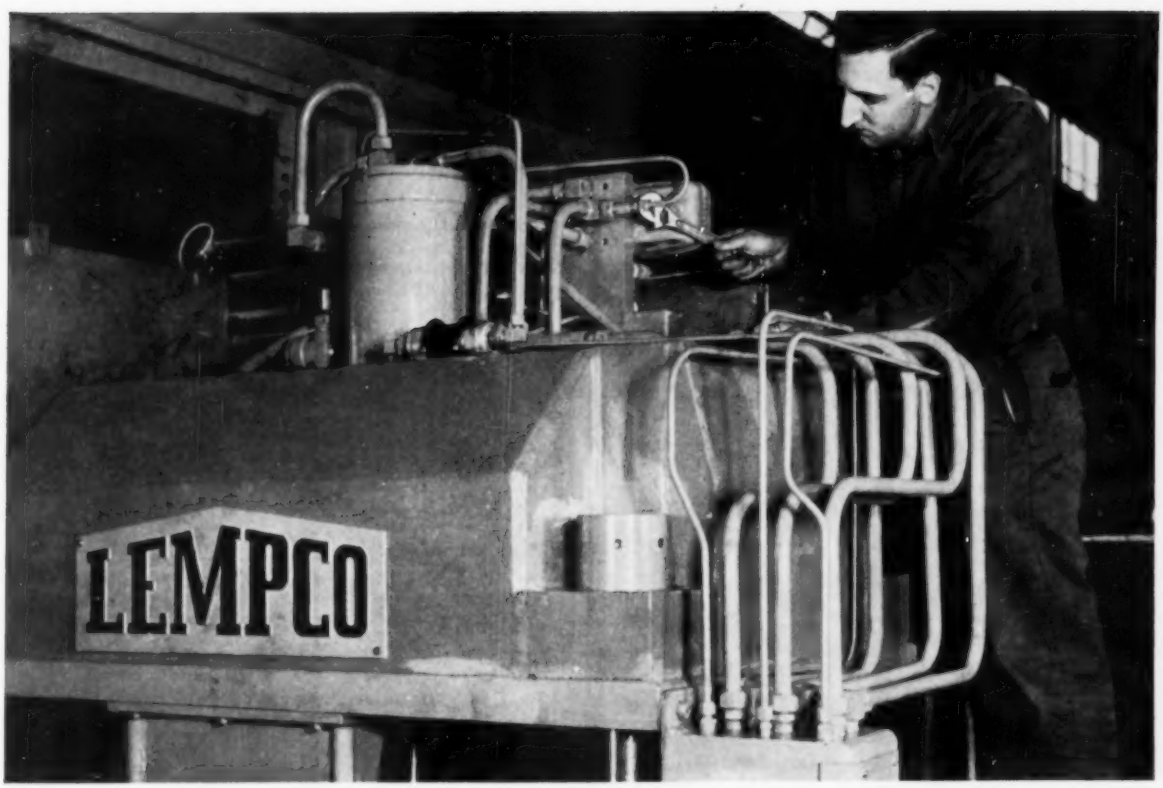

LEMPCO... builds dependability into 100-Ton Press with Republic ELECTRUNITE Hydraulic Line Tubing

Through the years, LEMPCO Industrial, Inc., have designed, engineered, and built hydraulic presses for a variety of industrial purposes. Recently, one of their most critical customers included resistance welded tubing as acceptable in their specifications.

Republic ELECTRUNITE® Hydraulic Line Tubing was used for this order of 100-ton presses for molding plastics. Result: Greater built-in dependability and economy.

With ELECTRUNITE, quality is built-in. ELECTRUNITE is produced from highest quality flat-rolled open-hearth steel made in Republic's own mills to Republic's rigid specifications.

The exclusive ELECTRUNITE process is a continuous electric resistance weld method that unites the wall under pressure without the addition of foreign or added metal. Both the inside and outside surfaces can be checked for defects. Quality you can measure is built-in.

ELECTRUNITE is uniform. Uniform heat treatment assures uniform flaring characteristics. Close dimensional tolerances maintained in the drawing operation assures ease of assembly, reducing installation and maintenance costs.

Exacting outside dimensional tolerances assure a tighter joint at the fitting, reducing the possibility of leakage. And the overall uniformity of ELECTRUNITE assures fast, economical assembly with either flare, non-flare, or socket-brazed type of tube fittings.

Every length of ELECTRUNITE is hydrostatically tested or FARROWTESTED® (Republic's exclusive non-destructive electrical test) to MIL-T-17188 or A-214.

To learn more about Republic ELECTRUNITE Hydraulic Line Tubing, call your distributor, or write direct.

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STEEL AND TUBES DIVISION

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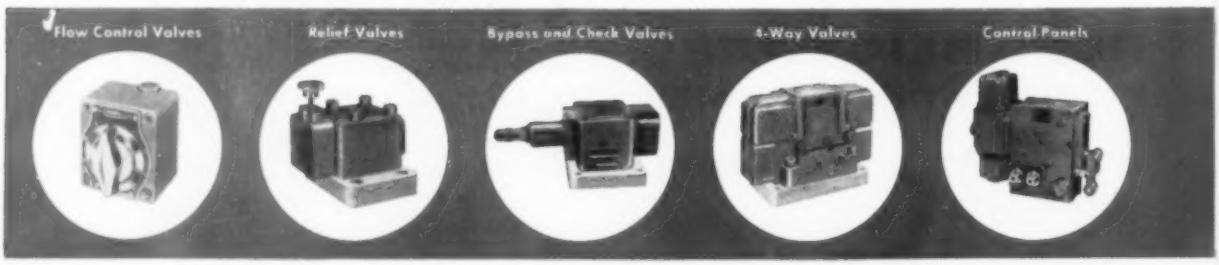

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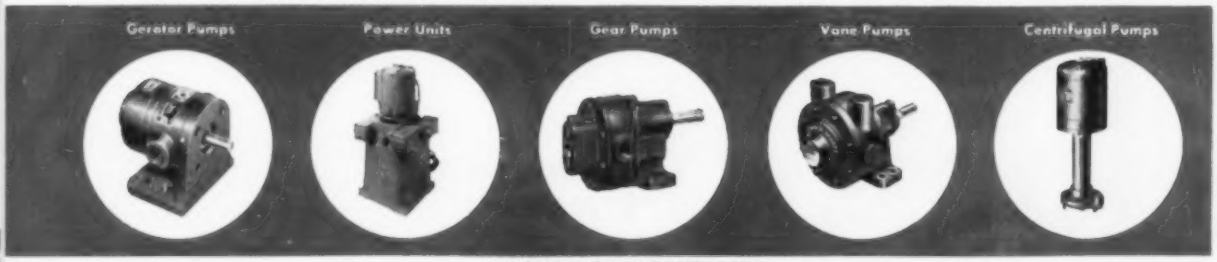

CIRCLE 25 ON TIME-SAVER CARD

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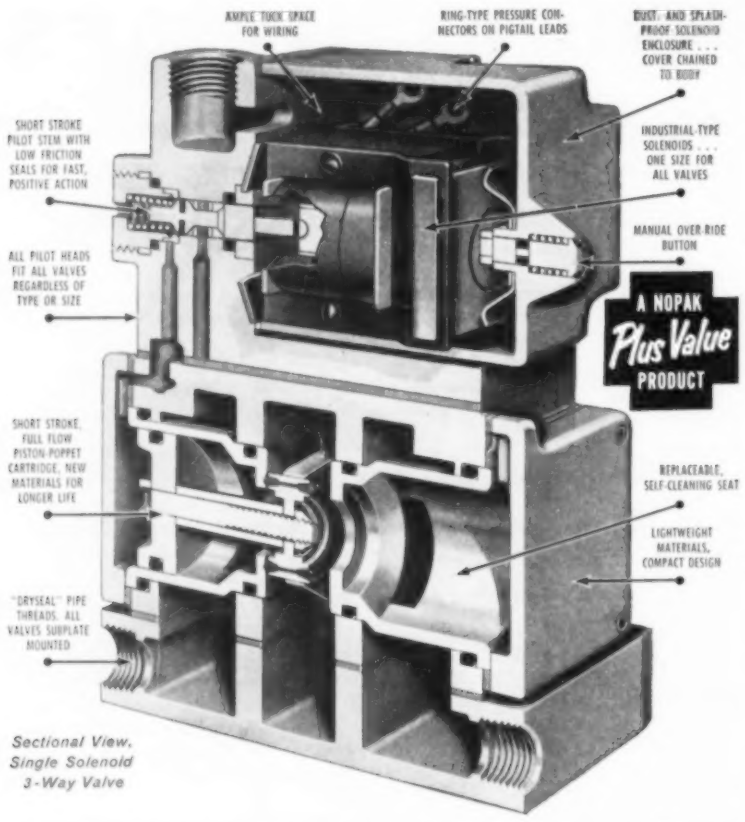
New Standards of Precision Control ... in Air Cylinder Operation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Sectional View. Single Solenoid 3-Way Valve

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Available in ¼" thru ¾" pipe sizes for 3-Way and 4-Way operation with air, single or double solenoid pilot.

For the complete Nopak-matic Story, see Catalog 105

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CIRCLE 54 ON TIME-SAVER CARD

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Wants High Pressure Reducing Valve

TO THE EDITOR:

We manufacture an air-powered tubing splicer used in the oilfields. In the system is a pressure regulator which reduces tank air pressure from 120 psi to 35 to 60 psi.

We sometimes furnish the same equipment for hydraulic operation.

Please advise if anyone manufactures a similar spring-loaded pressure-reducing valve that will reduce line pressure from 3000 psi to 175 to 200 psi with a flow of 6 to 10 gpm.

WALDO MOORE
Oil Tool Co.
Long Beach, Calif.

There are a number of manufacturers of pressure reducing valves for hydraulic systems. However your pressure ranges are quite severe. A list of companies that manufacture valves for 3000 psi has been sent you. Perhaps they can modify one of their standard valves to give you this pressure range.

Reservoir Design

TO THE EDITOR:

I was interested to see the article on design of reservoirs in the August issue of APPLIED HYDRAULICS, particularly illustration No. 4 on page 79 which apparently was taken from our bulletin 600.

We were disappointed to see that there was no credit given us for this unusual design.

ADDISON T. SMITH
The Airoyal Co.
Maplewood, N.J.

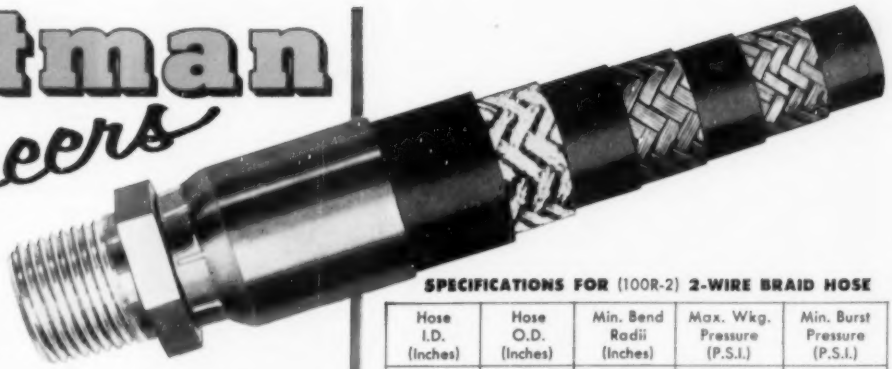
Sorry we neglected to put a credit line under the drawing of the reservoir. We certainly were aware that it was your design. You will recall that in July 1953 we did

Continued on page 20

Eastman

engineers the way

TO HIGHER PRESSURES



Eastman engineering is making possible ever-increasing advances in hydraulic pressures through:

- Couplings designed to exceed minimum *burst* pressure —four times actual working pressure.
- Hydraulic application of couplings to hose, assuring maximum grip—within specified hose tolerance.
- Maximum orifice—designed to improve fluid flow, reduce friction and increase power delivery.
- More rigid testing of completed assemblies to reveal additional opportunities for improvement.

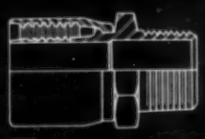
Let Eastman engineers help you increase the "power-performance ratio" of your product to improve your competitive position in your field.

SPECIFICATIONS FOR (100R-2) 2-WIRE BRAID HOSE

Hose I.D. (Inches)	Hose O.D. (Inches)	Min. Bend Radii (Inches)	Max. Wkg. Pressure (P.S.I.)	Min. Burst Pressure (P.S.I.)
¼	11/16	4	5000	20000
⅜	27/32	5	4000	16000
½	31/32	7	3500	14000
¾	1 ¼	9½	2250	9000
1	1 5/16	9½	1875	7500
1 ¼	2	16	1625	6500
1 ½	2 ¼	20	1250	5000
2	2 ¾	22	1125	4500

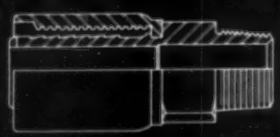
PERMANENTLY ATTACHED COUPLINGS

For 2-wire braid hose. Offers maximum coupling strength, strong hose attachment and improved orifice for rapid, friction-free fluid flow. For working pressures up to 5000 psi. See Pages 10 and 11.



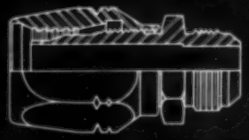
HIGH PRESSURE COUPLINGS

For EXTREME high pressures up to 7000 psi working pressure. Eastman engineered for greater power delivery and performance. For specifications and sizes, send for New Eastman Bulletin 200, below.



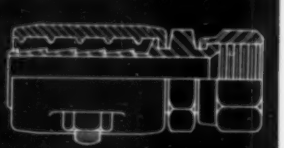
2-PIECE REUSABLE COUPLINGS

For 2-wire high pressure hose up to 5000 psi working pressure. Increases serviceability of your equipment through easy replacement in the field. See new Bulletin for complete details.



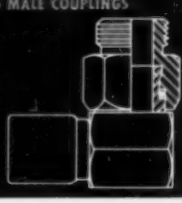
CLAMP TYPE COUPLINGS

Accurate machining assures alternate positioning of clamp ribs between each barb of insert—creating exclusive Inter-Lock grip—available to you only through Eastman. Pages 14 and 15.



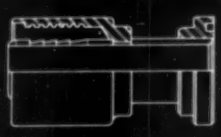
SWIVEL "O" RING MALE COUPLINGS

Permits easy assembly in close quarters, easy positioning of hose in 45° and 90° angles. Economical, reduces number of threaded connections. Dimensional drawings, sizes, and specifications in new Bulletin.



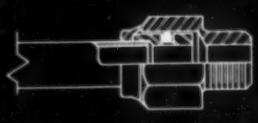
FLANGE HEAD COUPLINGS

Offer advantages of permanent hose attachment plus Split Flange Head Couplings with 0° to 90° stems. Economy plus user convenience. Specifications and sizes listed in new Bulletin.



TUBING ASSEMBLIES

Swivel Male "O" Ring Tube Nut used on tubing assemblies. Eastman offers formed tubing with beaded or flared ends—to your requirements. Specifications and sizes on Page 30.



Eastman

first in the field **MANUFACTURING COMPANY**

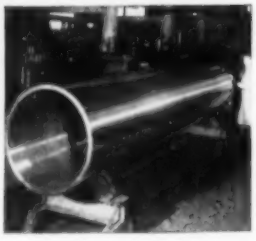
Dept. AH-10, MANITOWOC, WISCONSIN

Write FOR YOUR NEW BOOK— WITH THAT NEW LOOK!

- A NEW Service Concept.
- A NEW High in Convenience.
- A NEW Ease in Specifying— according to your pressure requirements.

SAFEGUARDING AMERICA'S LIFELINES OF MOBILE POWER

CIRCLE 46 ON TIME-SAVER CARD



You get stronger, longer-lasting components with

SHENANGO CENTRIFUGAL CASTINGS

Even under the severest hydraulic service, you'll always get peak performance from Shenango centrifugally-cast components. They have a uniform, *pressure-dense* grain which makes for unusual strength and wearability. They are remarkably free from inclusions and porosity. And you'll find a *minimum* of machining is needed to attain a *maximum* of finish.

Shenango offers you cylinders and all symmetrical components in a wide range of sizes, shapes and dimensions . . . in most any non-ferrous metal or tough Meehanite metal . . . and rough-machined *or* finished to your exact specifications.

Shenango also offers a broad range of centrifugally-cast tubular bar stock to meet standard *and* specialized requirements.

For the full story on Shenango's modern centrifugal casting process and products, write to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE® METAL • ALLOY IRONS

CIRCLE 113 ON TIME-SAVER CARD

LETTERS

a full page article on this design and that's where we picked up the information. Hope you'll forgive the oversight.

Fluid Maintenance

TO THE EDITOR:

I hasten to extend my compliments on the fine job done on Filters and Fluid Maintenance in the August issue of APPLIED HYDRAULICS. Issues of this type will be extremely valuable to the fluid power industry, especially when they contain so much educational material.

I was also pleased to see the filter glossary.

WALTER J. KUDLATY
Chief Design Engineer
Miller Fluid Power Div.
Flick-Reedy Corp.

Thank you for your nice note concerning our August issue. We greatly value your comments and suggestions at all times.

We will incorporate much of this basic information in the design section of our biennial Fluid Power Directory.

Text On Hydraulics

TO THE EDITOR:

We are very much interested in courses like that of Dr. J. L. Shearer at MIT on Fluid Power Control and Dr. F. D. Carvin at Illinois Institute of Technology on his NCIH course in oil hydraulics. I have written both of these men for information on the text they use and their course outlines.

We would appreciate any information you could give us on texts, names and publishers in this field.

PARK L. TURRILL
Chairman Division of Science,
Engr., & Math.
Glendale College
Glendale, Calif.

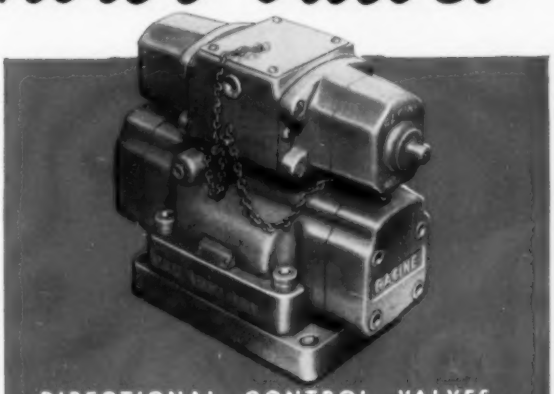
We've sent a reprint from our FLUID POWER DIRECTORY *which gives you a list of the books available on fluid power. We have also sent a sheet which describes the*

Continued on page 22

RACINE-SECO

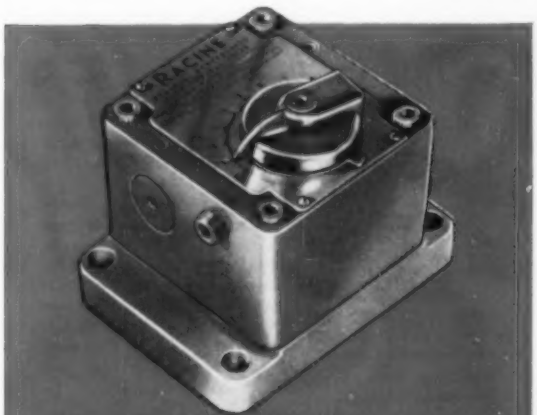
Hydraulic control valves

Racine-Seco hydraulic circuit components are the result of years of experience in engineering and development. Shown here are representative types of a complete line of quality-designed, quality-built dependable control valve equipment that will efficiently perform their specific function in today's modern hydraulic circuit design.



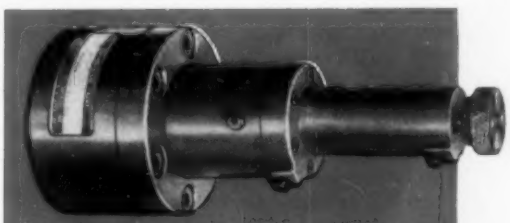
DIRECTIONAL CONTROL VALVES

Compact streamlined design — dust proof construction. Mechanical, manual, pilot and electrical operation available in 2 way and 4 way valves — foot and panel mounting. Sizes 1/4" to 2" — 1500-2000-3000 PSI. Complete line of pilot operated, spring loaded, angle type and straight check valves available from 1/4" to 2"



VOLUME CONTROL VALVES

Used to maintain a constantly-metered flow regardless of pressure fluctuations in either the inlet or outlet ports of the valve: Capacities from 5 cu. in./min. to 60 gpm. Sizes 1/4"-3/8"-1/2" and 1 1/2" I.P.S.



PRESSURE CONTROL VALVES

Designed to provide sensitive precision control of pressures up to 10,000 PSI. Complete line includes Relief, Unloading, Sequence, Counter Balance, Reducing and Resistance Valves. Capacities up to 60 gpm.

All RACINE-SECO Hydraulic Control Valves are designed to conform to J.I.C. specifications. Write for complete descriptive Catalog 59-A.

RACINE HYDRAULICS & MACHINERY, INC.

2074 Albert Street RACINE, WISCONSIN

One Source — One Responsibility FOR ALL YOUR HYDRAULIC NEEDS

Helping Hands

TO SOLVE *TOUGH* SEALING PROBLEMS

Taming the tough ones is day-in-day-out routine at Aero Gasket . . . yet our service is *specialized,* with diaphragms being *custom* molded to meet rigid specifications . . . customer, commercial, military.

We maintain a complete laboratory to insure quality control of every product from design to final delivery. We have developed special designs to meet a wide range of specific applications where long flexing life, wide temperature ranges and high operating pressures are major requirements.

Send us your specifications. We'll be pleased to provide specific recommendations that will solve your problems.

Aero Gasket produces, in a wide range of materials and assemblies . . .

GASKETS • DIAPHRAGMS • MOLDED RUBBER PARTS • METAL STAMPINGS
METAL TO RUBBER BONDING

THE
AERO GASKET
CORPORATION
770 Hanover Street, Meriden, Connecticut
CIRCLE 3 ON TIME-SAVER CARD

LETTERS

contents of the directory. It is one of the most complete basic texts on fluid power and gives complete information on available components.

Airborne Compressors

TO THE EDITOR:

The Cornelius Company would like to correct the erroneous impression given in your article on airborne compressors as it appeared in your April issue.

Unfortunately, a reader of your article was led to believe that The Cornelius Company manufactures only two airborne compressors, both of which are dc motor driven and are very small in capacity. This, of course, is not so, and so that we may set the record straight, here are the correct facts:

1. Cornelius manufactures 36 models ranging in capacity from .4 to 10 cfm. Most of these models are in current production including an 8 scfm, 3000 psi compressor used on North American's new A3J aircraft.
2. Cornelius is the *only* airborne compressor manufacturer that designs and manufactures its own compressor drives. All Cornelius compressors are available with Cornelius explosionproof ac and dc electric motors as well as Cornelius hydraulic motors or with pads for engine mounting.

A photo of a Cornelius compressor was conspicuous by its absence in your April issue. In fact, our current advertisement shows 10 of the 36 models now available.

J. W. MAHANAY
Sales Manager
The Cornelius Company
Aero Division
Minneapolis 21, Minn.

We appreciate your setting the record straight. Sorry we didn't have this information to include in our roundup article published in April.

Use a
TIME-SAVER CARD
for more information on advertised products, new products and free literature. It's between pages 118-119.

New VICKERS® Electro-Hydraulic Servo Valve

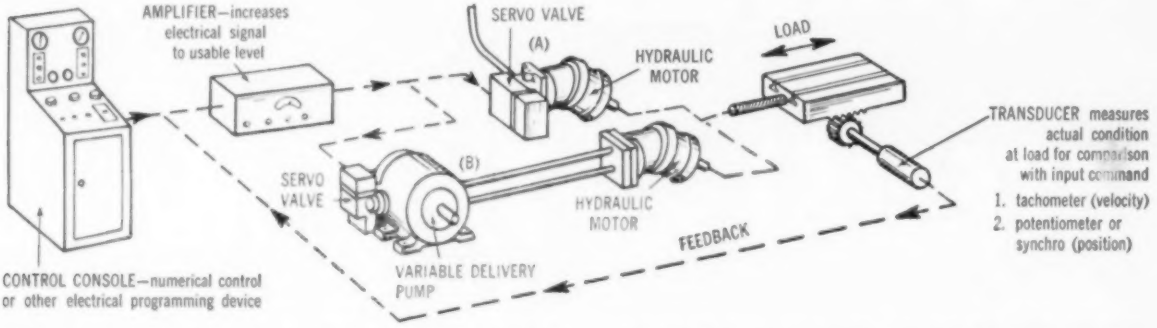
has numerous advantages for industrial use:

- ***Extremely Accurate***
- ***Simple • Rugged • Dependable***

Vickers Electro-Hydraulic Servo Valve integrated with piston type hydraulic motor provides a minimum amount of oil under compression. Integral cross line relief valves are provided as well as variable cross line orifice for controlling viscous damping. This "package" can provide approximately 20 hp @ 3000 psi and 3600 rpm; variable speed of motor is 0-4400 rpm.

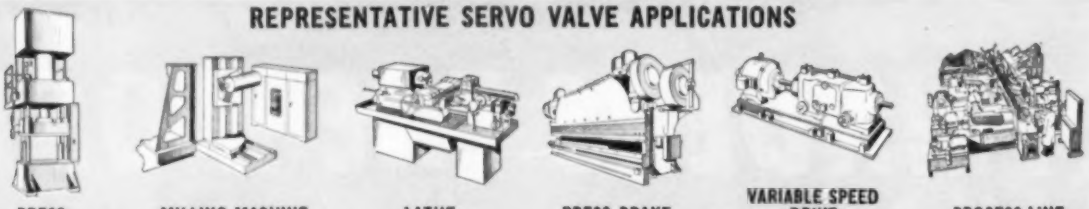
This valve provides a simple, dependable means of translating control signals from electronic programming into extremely accurate modulated flow of hydraulic power for fast and precise closed loop control of position, velocity and acceleration. Performance has been proven on machine tools, industrial processing equipment and ground ordnance applications.

Simplicity and reliability are exceptional . . . only four moving parts are required. Mechanical feedback linkage with unique variable fulcrum provides optimum flexibility for various conditions of flow, response and pressure. For further information, write for Vickers Engineering Bulletin 58-74.



Now the flexibility of electronic control can easily be applied to versatile hydraulic power. Vickers new industrial electro-hydraulic servo valve is used (A) to directly regulate the oil to an actuator (valve motor system). Shown in blue is an alternate application (B) for higher flows when the valve controls a variable volume pump (servo pump system).

REPRESENTATIVE SERVO VALVE APPLICATIONS



PRESS
Ram velocity controlled accurately during all cycles.

MILLING MACHINE
Precision control of velocity, position and acceleration of slides and tables.

LATHE
Exact feed rate and position control of cutting tool.

PRESS BRAKE
Cylinders synchronized precisely.

VARIABLE SPEED DRIVE
Accurate velocity control of spindle speeds for test stands or machine tools.

PROCESS LINE
Programmed control of Material Handling and machine sequencing.

8126

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

CIRCLE 130 ON TIME-SAVER CARD

THERE ARE REASONS BASED ON ENGINEERING

NOT GADGETRY

PRINCIPLES, -ON STRENGTH OF

NOT ME-TOO-ISM

MATERIALS, -THAT MAKE *Pathon* HYDRAULIC CYLINDERS THE MOST ADVANCED IN THE INDUSTRY TODAY!

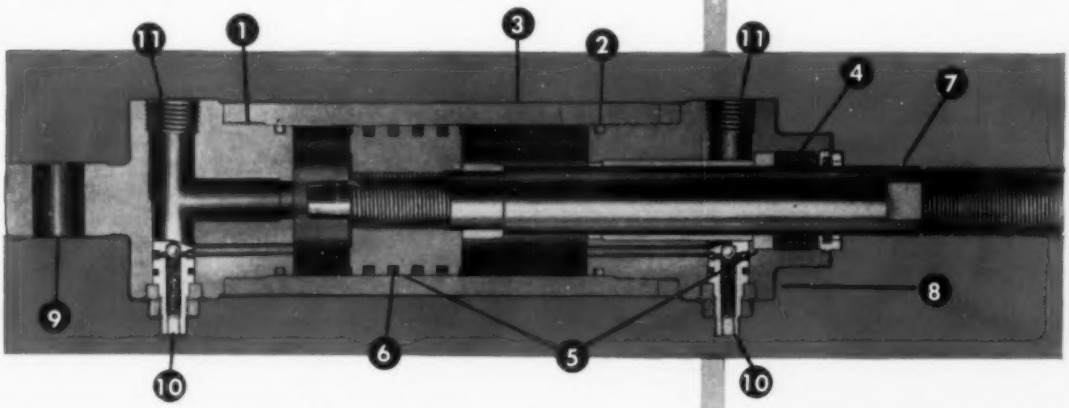
Consider Design...

Hydraulic cylinders, like any other devices, must be designed with a primary object in mind. Compromises must then be made with this primary object for secondary considerations, such as: shall certain features be sacrificed so that the device may be made from the least expensive materials; shall this or that other feature be sacrificed to minimize tooling costs; and so on.

Since all designs are compromises to some extent, it behooves the cylinder designer, ideally, to reject all compromises which tend to penalize the user.

Pathon, with its single screw thread design, has without doubt been able to most nearly approach this designer's ideal.

Pathon Hydraulic Cylinders are designed from the ground up, and tooled from the ground up, to be hydraulic cylinders having maximum strength, rigidity, durability, mounting versatility, minimum end mounting size, greatest ease of maintenance, and an appearance consistent with modern machine design.



Consider Application...

Pathon Hydraulic Cylinders are available in nine mounting types, thirteen bore sizes—1⅛" through 14", and two Series—for 1,000 PSI and 2,000 PSI. All mountings are either integral with the heads where applicable, or retained with threads on the O. D. of the barrel. No angles, loose blocks, loose plates, weldments, stampings, or similar adaptors are used. Naturally, Pathon Cylinders conform to J. I. C. Standards.

From one source, you can obtain all of your cylinder requirements *As Standard Units* whether you need to move 30 lbs. ¼ inch, or 300,000 lbs. 20 feet.

Consider Maintenance...

You do not have to disassemble Pathon Hydraulic Cylinders to replace the rod packing.

You can remove the rod end head and piston rod assembly on small cylinders (4" bore and less) within two or three minutes. Larger ones, due simply to their weight, may require a longer time.

When you disassemble a Pathon Hydraulic Cylinder, you remove only the part you intend to remove. You do not, for example, disassemble the rod end head and end up with a dozen or more loose parts. "A bag of bones and a hank of hair" may be fine for poetry, but a "bushel of bolts" can be exasperating when you are trying to get a job done.

1 Heads retained with a single screw thread for maximum strength, rigidity and minimum size.

2 O-ring head seal in close fitting pilot. Long pilot maintains concentricity.

3 Heavy wall seamless steel tubing for strength *allows generation of precision bores.*

4 Multi-lip packing for longer life—*externally replaceable.* Rod bearing inboard to packing where it gets *lubrication.*

5 Relatively long span between piston and rod support *resists side loads with reduced unit bearing force.* This eliminates need for "stop tubes" even on long stroke cylinders.

6 Either standard ring type or U-cup type piston available. Both may be *readily installed without special tools* or collapsing devices.

7 Hard chrome-plated piston rod standard. Hardened and chrome-plated alloy steel rods, ground *after hardening for straightness,* optional.

8 Minimum mounting area required on all end mounted units.

9 Integral mounting pads for *rigidity* and *permanence.* No welding, no brackets.

10 Cushion adjustment requires only 180° turn from full open to full closed. *Makes setting cushions easy.* Equipped with locking nut. *No change of position after setting.*

11 Ports may be located in *any position* relative to each other.

12 No *tie-rods* to *stretch,* or tie-rod *nuts* to *coin* into the *heads* under heavy loads.

Pathon MANUFACTURING CO.

3823 PACIFIC AVE. CINCINNATI 12, OHIO

CIRCLE 95 ON TIME-SAVER CARD

BRIEFS about fluid power

BDSA TO SURVEY FLUID POWER INDUSTRY

WASHINGTON, D. C.—An important survey of the fluid power industry will get underway this month. It's being conducted by the general industrial equipment and components division of the Business and Defense Services Administration (BDSA), U. S. Department of Commerce.

Manufacturers of pumps, fluid motors, cylinders, compressors, valves and accumulators will be surveyed to determine:

1. 1957 shipments (in dollars)
2. 1957 consumption of carbon, alloy, and stainless steel; copper and copper base alloy, aluminum, and alloys of 30% or greater nickel content.
3. Information on end use of these components for: industrial, airborne, marine and ordnance and mobile (except passenger cars) applications.

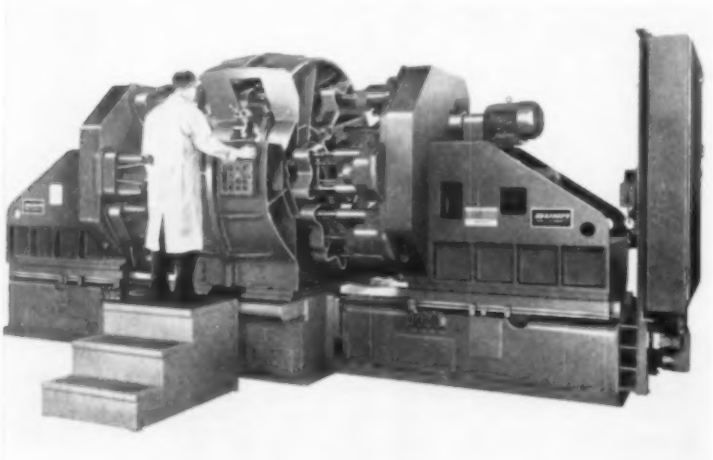
Results of this survey will be compiled by BDSA. James W. Anderson, BDSA coordinator, emphasized that only composite results will be made available. Unauthorized disclosure of individual company information is prohibited by law.

At the present time, no comprehensive statistics as will be developed by the survey are available. Wide application of fluid power to military programs and in basic industries has resulted in the need for this survey. This information is needed by BDSA to carry out its responsibilities as representative of industry in government.

The survey is being made on the recommendation of the Fluid Power Industry Advisory Committee of the Business and Defense Services Administration. This government industry advisory committee consists of sixteen industry members representing broad coverage in size of concerns, products manufactured, and geographical locations. ▼▼▼

HYDRAULIC SYSTEM FOR SET-UP EASE

Many different parts can be made on a line of short run automatic machines developed by Buhr Machine Tool Co., Ann Arbor, Mich. A typical machine drills, bores, reams, taps and chamfers 36 hydraulic valve bodies of different sizes and having ing holes of different sizes in various locations.



• **Standard Components**—The machines are assembled from standard components but each has a control circuit tailored to the type of parts to be machined.

• **Hydraulic Feeds**—Two horizontal hydraulic feed units are included in the double-end trunnion-type machines. Tool heads are fed hydraulically and feed rates are established by controlling fluid flow.

• **Feed Rates**—Different feed rates within a machining cycle are obtained by using several flow control units and proper valving. In the typical machine of this design four different rates are achieved with three flow control units. Rapid advance is obtained by permitting the hydraulic fluid to flow from the rod end of the tool platen cylinder to the tank without restriction. On this machine only one fine feed rate is used with either of the coarse

Continued on page 28

Champion performance in a fist-sized pump...sealed by C/R

THE PROBLEM:

To seal a rotary pump handling a wide range of fluid viscosities, pressures and temperatures

These pumps are performing dependably in hundreds of different hydraulic applications. They handle any fluid with lubricating qualities . . . deliver up to 180 gph, and maintain high volumetric efficiency even with low viscosity fluids. This particular pump also carries Underwriters' Laboratories approval for use in oil burners. For dependable sealing, C/R's Type HMS Oil Seal was chosen. It performs effectively from 28" Hg to 5 psi, and from 50 to 8000 rpm. This is only one of the thousands of ways in which C/R Oil Seals and engineering are solving difficult sealing problems throughout industry. C/R engineers can help you, too—especially where critical conditions exist. A letter or telephone call will get them started for you. Write for your copy of the catalog, "C/R OIL SEALS."

More automobiles, farm and industrial machines rely on C/R Oil Seals than on any similar sealing device.

CHICAGO RAWHIDE MANUFACTURING COMPANY
1203 ELSTON AVENUE • CHICAGO 22, ILLINOIS

Offices in 55 principal cities. See your telephone book.

In Canada: Manufactured and Distributed by Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario. **Export Sales:** Geon International Corp., Great Neck, New York

C/R PRODUCTS: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears

OIL SEAL C/R DIVISION

CHICAGO RAWHIDE

CIRCLE 29 ON TIME-SAVER CARD

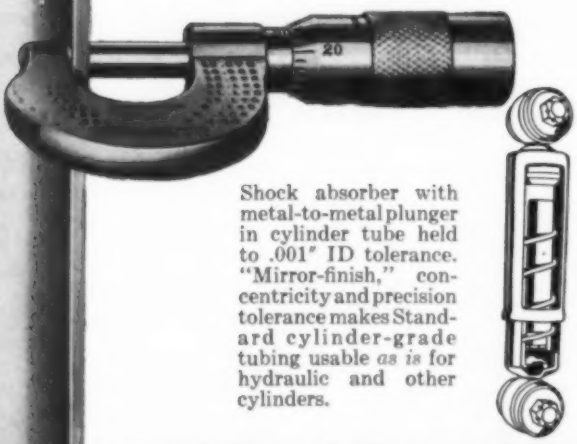
CYLINDER TUBING . . .

"mirror-finished" by Standard

Standard "mirror-finished" cylinder tubing is full-finished to use without further sizing or finishing for such applications as *automobile shock absorbers, power steering* and *hydraulic pumps.* When it comes to punishment, it can really take it. Every inch of this rugged tubing measures up to exacting specifications in cylinder finish . . . in ID tolerances as close as .001" . . . in extreme uniformity of wall thickness and concentricity . . . in internal pressure resistance, *tested to shocks up to 9000 p.s.i.* Cylinder sizes to 3½" OD x .187" wall. For full information on Standard's complete range of products, plant facilities and engineering assistance send for *free* folder below.

- Welded Stainless Tubing and Pipe.
- Welded Carbon Steel mechanical.
- Boiler and Heat Exchanger.
- Exclusive rigidized pattern.
- Special Shapes.

Free 8-page folder on all Standard products. Write to address below.



Shock absorber with metal-to-metal plunger in cylinder tube held to .001" ID tolerance. "Mirror-finish," concentricity and precision tolerance makes Standard cylinder-grade tubing usable *as is* for hydraulic and other cylinders.

STANDARD

THE STANDARD TUBE COMPANY and MICHIGAN STEEL TUBE PRODUCTS DIVISION

24400 Plymouth Rd. • Detroit 39, Mich.

Welded stainless tubing and pipe • Welded carbon steel mechanical Boiler and Heat Exchanger • Exclusive rigidized patterns • Special Shapes • Steel Tubing—Sizes: ⅛" OD to 6" OD—.028 to .270 wall Stainless—Sizes: ¼" OD to 4¾" OD—.020 to .187 wall.

CIRCLE 117 ON TIME-SAVER CARD

BRIEFS

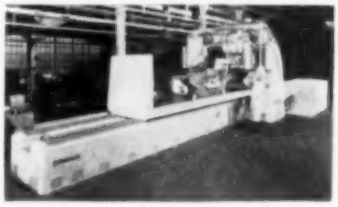
feeds, but any number of combinations of feeds is possible by adding more flow control valves and limit switches.

● **Automatic Work Cycle**—To initiate the automatic work cycle the operator loads and clamps workpieces in the fixture at the load station, and presses two index push buttons. The trunnion indexes one station and the heads automatically start their cycles. Interlocks protect the machine and the operator. ▼▼▼

ATTACHMENT TO invert liquid containers while in storage to prevent settling out. It uses two pairs of hydraulically operated forks. The lower pair fitting into the pallet on the bottom and the top pair bringing an empty pallet down on top of the load. It then rotates to turn the container upside down. The Yale & Towne Mfg. Co., Philadelphia, Pa.

Compensated Pump Reduces Heat

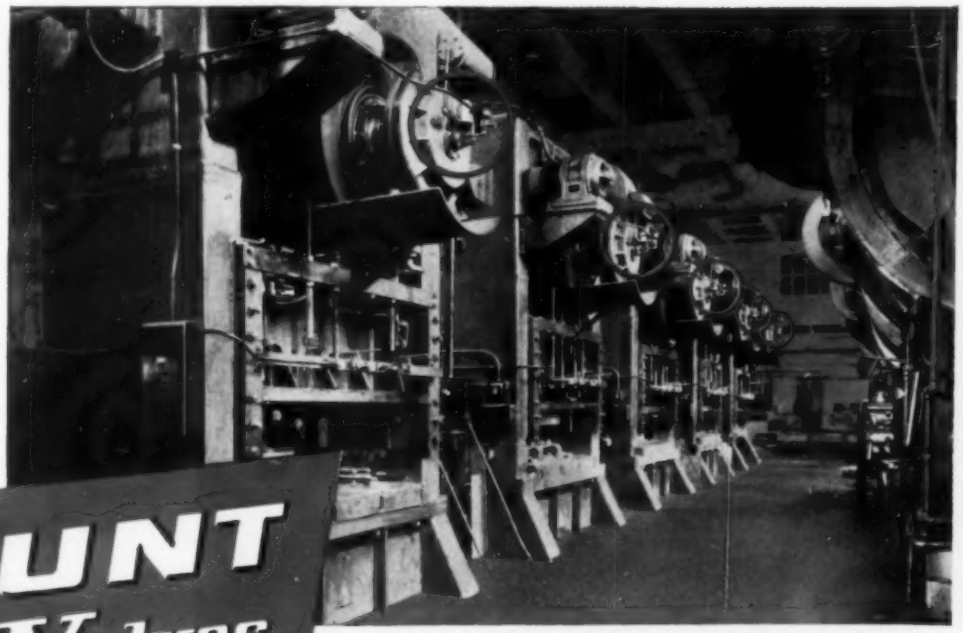
In large grinders any heat distortion is magnified porportionately to the length of the work



area. By reducing heat in the hydraulic system of this 20-ft grinder accuracy can be held to .0007 in.

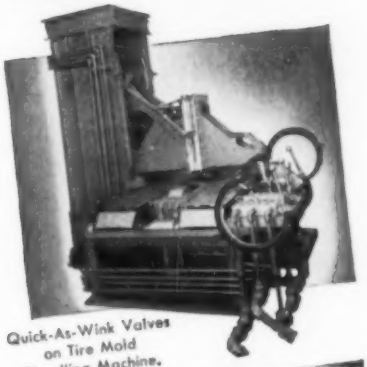
Made by the Thompson Grinder Co., Springfield, Ohio the ma-

Continued on page 30



Quick-As-Wink Solenoid Air Valves on Battery of Heavy Duty Presses.

HUNT CONTROL Valves



Quick-As-Wink Valves on Tire Mold Handling Machine.

Quick-As-Wink Valve on 8-spindle Automatic Chucking Machine.

proven dependable operation

no after hours Siss-s-s-s

That harsh sizzling noise you hear out in the plant, after the work force has gone home, is there during the day also. Only you can't hear it then. It's air, seeping out through inferior valves, wasting from $5.00 to $500.00 per month. And leaky valves mean sloppy machine control; danger of "repeating"; possible injury to the operator; or a breakdown involving costly repairs, material spoilage, lost production and customer ill-will.

Stop the s-i-z-zling by installing Hunt valves on all your air and hydraulic controls. Positive and fast-acting Hunt valves are designed and built to seal tightly, preventing leaks, and minimizing the danger of breakdowns and tie-ups. Sizes from ⅛″ to 8″. 29 Hg vacuum to 250 p.s.i.; up to 5000 p.s.i. on oil and water. *Zero leakage.* Recognized by operators, foremen and superintendents everywhere for unsurpassed economy, low maintenance and long, efficient service.

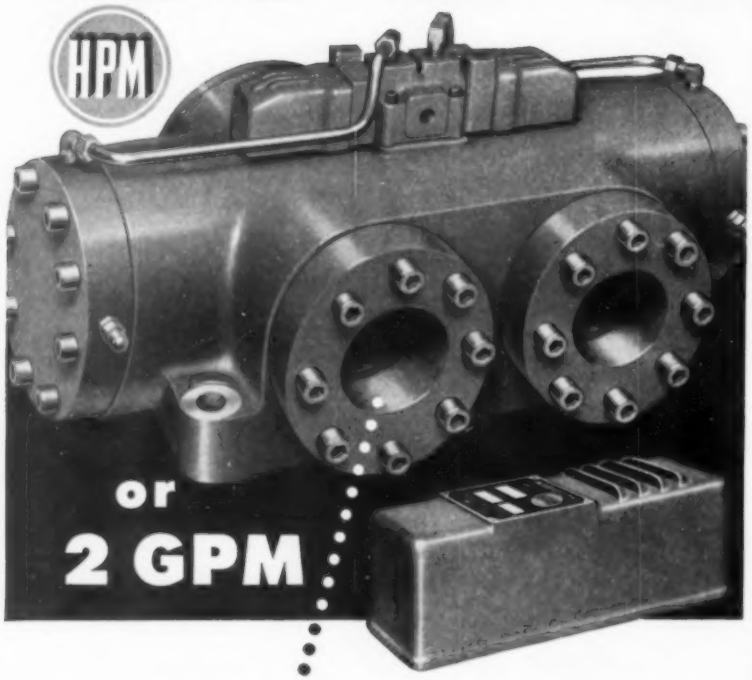
HUNT

Quick-As-Wink® AIR AND HYDRAULIC CONTROL Valves

Manufactured by HUNT VALVE COMPANY, 1991 East Pershing St., Salem Ohio

CIRCLE 68 ON TIME-SAVER CARD

450 GPM



New 4" Solenoid operated Pilot Controlled Four-way valve handles 450 gpm at 15 ft/sec. Six spool types with adjustable choke pilot end covers.

This 1/8" four-way valve is the smallest in the H-P-M line and handles 2 gpm at 15 ft/sec. velocity. Six spool types.

BIG or small H-P-M gives You One Source for Complete Satisfaction

Whatever your needs, H-P-M has the experience and the hydraulic components to handle your requirements. Big or small—standard or special—call your H-P-M Hydraulic Power specialist in your area or write headquarters at Mount Gilead. Valves to 700 gpm also available.

HB13

HPM

HYDRAULIC POWER DIVISION
THE HYDRAULIC PRESS MFG. COMPANY
A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U. S. A.

CIRCLE 70 ON TIME-SAVER CARD

BRIEFS

chine uses the company's patented Hydra-Cool hydraulic system. (Described in May issue APPLIED HYDRAULICS.) Heart of the system is a vane pump with integral stroke control for pressure and volume compensating. Pressure from each side of a flow control valve is applied to stroking cylinder to control pump displacement. Table speed is changed by adjusting flow control valve. The system reduces heat by adjusting hp to work requirements. ▼▼▼

USE OF FLUID POWER enables Rockwell Mfg. Co. to check visually liquefied petroleum gas meters for leakage. The testing apparatus consists of a hydraulically operated water bath, four plate glass windows, an air pump and service regulator. Air lines are clamped to the meter. The regulator keeps the internal meter pressure at twice the normal working pressure.

Pneumatic Conveyor for Pulverized Material

Pneumatic conveying of powdered stabilizer for asphalt roofing compound cut manhours 75 percent at the Ruberoid Co., Joliet, Ill. The system was installed by Fuller Co., Catasaqua, Pa. It distributes 34 tons of stabilizer per hour to three separate locations in the plant.

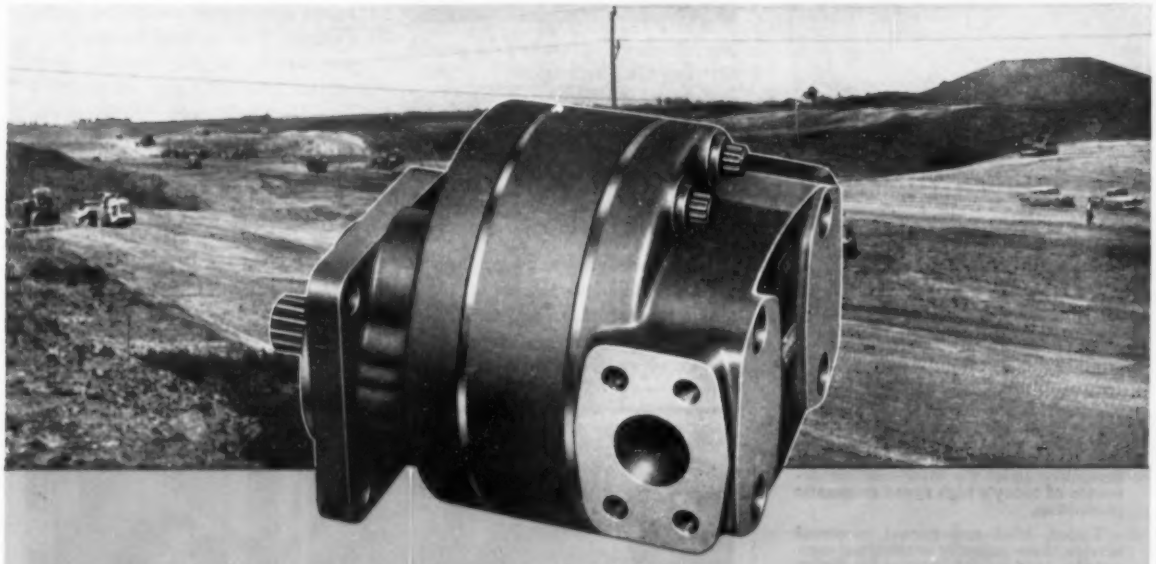
• **How it operates**—Stabilizer material enters pump hopper by

Continued on page 32

capacity for Big payloads

Now you can have all the advantages of Webster pumps in capacities up to 124 gpm. New "HF" series are high capacity, gear-type pumps especially designed for heavy earth moving and construction equipment. Built to perform under heavy shock loads, long continuous operation. The "HF" series is available in 5 sizes, with capacities from 18 to 124 gpm, operating pressures up to 1500 psi and operating speeds to 2400 rpm. Like all Webster hydraulic pumps, the new big capacity series is compact for easy adaptation to your product . . . operate at maximum efficiency on low power requirements.

NEW Webster "HF" SERIES HYDRAULIC PUMPS



These Webster features mean QUALITY!

1. **Integral drive, idler shaft and gear assembly.**
2. **High capacity roller bearings at all four bearing points.**
3. **Ball bearing to absorb end thrust.**
4. **Internal splined shaft (no keying problems).**

WRITE for facts, figures and data on the new Webster "HF" series pumps.

Call the man from Webster

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

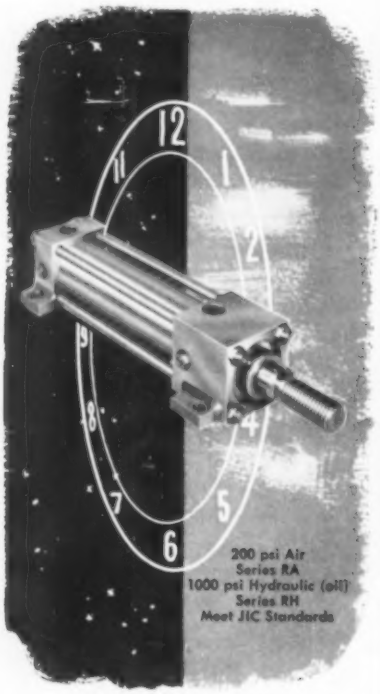
RACINE · WIS

CAPACITY RANGE OF "HF" SERIES PUMPS

Ratings shown are tentative standards which may be changed to meet your own requirements.

MODEL	GEAR WIDTH, INCHES	DISPLACE. CU. IN. PER REVOLUTION	GPM @ 1200 RPM & 1000 PSI	GPM @ 1800 RPM & 1000 PSI	GPM @ 2400 RPM & 1000 PSI
10 HFS	1	4.3	18	30	41
15 HFS	1½	6.5	28	45	61
20 HFS	2	8.6	38	60	83
25 HFS	2½	10.8	52	76	112
30 HFS	3	13.0	59	92	124

CIRCLE 135 ON TIME-SAVER CARD



FULL 'ROUND THE CLOCK OPERATION

O-M AUTOMATION
heavy-duty air and hydraulic cylinders

O-M Automation Air and Hydraulic Heavy-duty Cylinders are the result of years of research and engineering "know-how". Designed to the automotive industry's Automation Standards, they fill a definite need for outstanding durability under the most exacting demands of today's high speed automatic production.

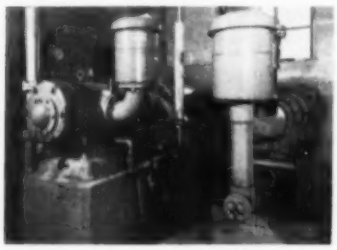
Tested, tried and proved in actual service, these ruggedly constructed components hold untold promise for design engineers who seek to combine continuous, smooth dependable and efficient straight line motion with long life and minimum maintenance. Available in 1½" to 8" bores with front flange, rear flange, clevis, trunion or foot mount.

These and many other advanced features of O-M Automation Cylinders, that make for maximum efficiency and long life with minimum servicing, are described in our new catalogues—107 for Air Cylinders—108 for Hydraulic Cylinders. Write for your copy TODAY!

ORTMAN-MILLER MACHINE COMPANY
1 143rd Street, Hammond, Indiana
☐ Have representative call
☐ Send Bulletins 107 and 108
Name_____ Position_____
Company_____
Address_____
City_____ Zone_____ State_____
CIRCLE 91 ON TIME-SAVER CARD

BRIEFS

gravity and is advanced through the barrel of pump by an impeller screw. As the material moves through the barrel it is compacted by the decreasing pitch of the impeller screw flights and the variable space between the last flight



and the check valve. It then passes through the check valve to a mixing chamber where compressed air is introduced through a series of air jets. Material in this fluid state enters the transport line and is advanced as a dense column at low velocity.

• **Compressor**—Low pressure air is supplied to the pump by a single stage rotary compressor delivering 403 cfm at 20 psi. No air receiver is needed since the compressor automatically adjusts output pressure to pump needs. Compressor blades are forced against the cylinder wall by a centrifugal force, automatically compensating for wear. ▼▼▼

New Books

Control Systems Components by John E. Gibson and Franz B. Tuteur, 493 pp, price $12.00, McGraw-Hill Book Co., Inc., New York, N. Y.

Book has 13 chapters on hydraulic, pneumatic, electrical and mechanical methods of control. The last four chapters are devoted to hydraulic and pneumatic systems and components. It contains an excellent description of both pump and valve controlled servo systems, flow control valves, flapper valves, nozzle valves, spool valves, and all types of positive-displacement pumps. Choice of operating pressures for both air and hydraulic systems are also discussed.

Trouble-Free Hydraulics by Ian McNeil, the Ronald Press Co., 121 pp, price $6.50.

Book was written for the practical engineer who is responsible

Continued on page 36

TWO SIDED aluminum billet scalper was developed by Consolidated Machine Tool Div., Farrel-Birmingham Co., Inc. Machine has 5 separate hydraulic systems for: loading leaf, unloading leaf, head clamping, head clutching, and unloading pick-up mechanism. The machine will be used to produce raw material from which to roll aluminum sheet, strip and foil.

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CIRCLE 120 ⟶

TROUBLE-SHOOTING CHART FOR HYDRAULIC SYSTEMS

CAUSE	WHAT TO DO
NOISY PUMP	
Air leaking into system	Be sure the oil reservoir is filled to normal level and that oil intake is below surface of oil. Check pump packing, pipe and tubing connections, and all other points where air might leak into system. One good way to check a point on the *intake* side suspected of leakage is to pour oil over it. If the pump noise stops, you've found the leak.
Air bubbles in intake oil	If oil level is low or return line to reservoir is installed above oil level, air bubbles will form in oil in reservoir. Check oil level and return-line position.
Cavitation (the formation of vacuum in a pump when it does not get enough oil)	Check for clogged or restricted intake line, plugged air vent in reservoir. Check strainers in intake line. Oil viscosity may be too high. Check recommendations.
Loose or worn pump parts	Check manufacturer's maintenance instructions first. Tightening every nut in sight may *not* be the way to stop leakage. Look for worn gaskets and packings; replace if necessary. There is usually no way to compensate for wear in a part; it is *always* better to replace it. Oil may be of improper grade or quality. Check recommendations.
Stuck pump vanes, valves, pistons, etc.	Parts may be stuck by metallic chips, bits of lint, etc. If so, disassemble and clean thoroughly. Avoid the use of files, emery cloth, steel hammers, etc., on machined surfaces. Products of oil deterioration such as gums, sludges, varnishes, and lacquers may be cause of sticking. Use solvent to clean parts and dry thoroughly before reassembling. If parts are stuck by corrosion or rust, they will probably have to be replaced. Be sure oil has sufficient resistance to deterioration and provides adequate protection against rusting and corrosion.
Filter or strainer too dirty. Filter too small	Filter and strainers must be kept clean enough to permit adequate flow. Check filter capacity. Be sure that original filter has not been replaced by one of smaller capacity. Use oil of quality high enough to prevent rapid sludge formation.
Pump running too fast	Determine recommended speed. Check pulley and gear sizes. Make sure that no one has installed replacement motor with other than recommended speed.
Pump out of line with driving motor	Check alignment. Misalignment may be caused by temperature variation.
LEAKAGE AROUND PUMP	
Worn packing	Tighten packing gland or replace packing. Trouble may be caused by abrasives in oil. If you suspect this sort of trouble, make a thorough check of points where abrasives may enter system.
Head of oil on suction line	Usually it is better to have no pressure on the suction side of the pump, although it may be necessary. With more than slight head, leakage may result. If head is not required and components can be rearranged, do so. Otherwise, don't worry about the leakage. Just wipe off the pump periodically, and, if feasible, install a drip pan. Don't let oil leak onto floor!
OVERHEATING	
Oil viscosity too high	Check oil recommendations. If you're not sure of viscosity of oil in system, it may be worth your while to drain the system and install oil of proper viscosity. Unusual temperature conditions may cause oil of proper viscosity for "working temperature" to thicken too much on way to pump. In this case, use of oil with higher viscosity index may cure trouble.
Internal leakage too high	Check for wear and loose packings. Oil viscosity may be too low. Check recommendations. Under unusual working conditions temperature may go high enough to reduce viscosity of recommended oil too much. Proceed with caution if you are tempted to try a higher viscosity oil.
Excessive discharge pressure	If oil viscosity is found to be OK, trouble may be caused by high setting of relief valve. If so, reset.
Oil cooler clogged	On any machine equipped with an oil cooler, it is probable that high temperatures are expected. If temperatures run high normally, they'll go even higher if oil cooler passages are clogged. If you find a clogged cooler, try blowing it out with compressed air. If this won't work, try solvents.
Poorly fitted pump parts	Poorly fitted parts may cause undue friction. Look for signs of excessive friction; be sure all parts are in alignment.
Low oil	If the oil supply is low, less oil will be available to carry away just as much heat. This will cause a rise in oil temperature, especially in machines without oil coolers. Be sure oil's up to level.

(continued on next page)

PERFORATED AND PUNCHED FOR YOUR CONVENIENCE

SUNOCO®

HYDRAULIC OILS FOR EVERY APPLICATION

CIRCLE 120

CAUSE	WHAT TO DO
PUMP NOT PUMPING	
Pump shaft turning in wrong direction	Shut down immediately. Some types of pumps can turn in either direction without causing damage; others are designed to turn in *one direction only*. Check belts, pulleys, gears, motor connections. Reversed leads on 3-phase motor are commonest cause of wrong rotation.
Intake clogged	Check line from reservoir to pump. Be sure filters and strainers are not clogged.
Low oil level	Be sure oil is up to recommended level in reservoir. Intake line must be below level of oil.
Air leak in intake	If any air at all is going through pump, it will probably be quite noisy. Pour oil over points suspected of leakage; if noise stops, you've found the leak.
Pump shaft speed too low	Some pumps will deliver oil over a wide range of speeds; others must turn at recommended speed to give appreciable flow. Find out first the speed recommended by the manufacturer; then, with a speed counter if possible, check the speed of the pump. If speed is too low, look for trouble in driving motor.
Oil too heavy	If oil is too heavy, some types of pumps cannot pick up prime. You can make a very rough check of viscosity by first getting some oil that is known to have the right viscosity. Then, with both oils at the same temperature, pour a quart of each oil through a small funnel. The heavier oil will take a noticeably longer time to run through. Oil that is too heavy can do great harm to hydraulic systems. Drain and refill with oil of the right viscosity.
Mechanical trouble (broken shaft, loose coupling, etc.)	Mechanical trouble is often accompanied by a noise that you can locate very easily. If you find it necessary to disassemble, follow the manufacturer's recommendations to the letter.
LOW PRESSURE IN SYSTEM	
Relief valve setting too low	If relief valve setting is too low, oil may flow from pump through relief valve and back to the oil reservoir without reaching point of use. To check relief setting, block discharge line *beyond* relief valve and check line pressure with pressure gage.
Relief valve stuck open	Look for dirt or sludge in valve. If valve is dirty, disassemble and clean. Stuck valve may be indication that system contains dirty or deteriorated oil. Be sure, therefore, that oil has high enough resistance to deterioration.
Leak in system	Check whole system for leaks. Serious leaks in the open are easy to detect, but leaks often occur in concealed piping. One routine in leak testing is to install pressure gage in discharge line near pump and then block off circuit progressively. When gage pressure drops with gage installed at a given point, leak is between this point and check point just before it.
Broken, worn, or stuck pump parts	Install pressure gage and block system just beyond relief valve. If no appreciable pressure is developed and relief valve is OK, look for mechanical trouble in pump. Replace worn and broken parts.
Incorrect control valve setting; oil "short-circuited" to reservoir	If open-center directional control valves are unintentionally set at neutral position, oil will return to reservoir without meeting any appreciable resistance and very little pressure will be developed. Scored control-valve pistons and cylinders can cause this trouble. Replace worn parts.
ERRATIC ACTION	
Valves, pistons, etc., sticking or binding	First, check suspected part for mechanical deficiencies such as misalignment of a shaft, worn bearings, etc. Then look for signs of dirt, oil sludge, varnishes and lacquers caused by oil deterioration. You can make up for mechanical deficiencies by replacing worn parts, but don't forget that these deficiencies are often caused by the use of wrong oil.
Sluggishness when a machine is first started	Sluggishness is often caused by oil that is too thick at starting temperatures. If you can put up with this for a few minutes, oil may thin out enough to give satisfactory operation. But if oil does not thin out or if surrounding temperature remains relatively low, you may have to switch to oil with lower pour point, lighter viscosity, or, perhaps, higher viscosity index. Under severe conditions, immersion heaters are sometimes used.

You can lick many of these problems by using the *right* oil. And, Sun has an oil for *every* application!

For larger copies of this chart suitable for posting on walls . . . or for more information on Sun hydraulic oils, call the Sun office nearest you.

INDUSTRIAL PRODUCTS DEPARTMENT

SUNOCO® **SUN OIL COMPANY** SUNOCO®

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SUNOCO®

HYDRAULIC OILS FOR EVERY APPLICATION

NO EQUAL IN SIMPLICITY!

ONLY 3 MOVING PARTS IN ASCO 3-WAY SOLENOID VALVES

Millions of Trouble Free Operations . . . are the result of the simplicity designed into ASCO 3-way solenoid valves. Fewer wearing parts mean substantial savings in maintenance costs . . . reduction in down-time losses.

Simple in construction, ASCO 3-way solenoid valves are simplicity itself in operation—solenoid piloting of two simple diaphragms. Absolutely tight seating is a feature—no closely fitted parts or valve seat grinding are required.

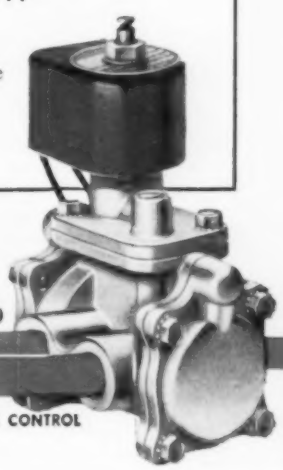
Exceptionally large flow capacity permits rapid filling and venting of cylinders . . . valves operate up to 400 cycles per minute.

Conversion from normally open to normally closed—or the reverse—takes just 30 seconds; only simple rotation of the valve bonnet required.

ASCO 3-way valves can be supplied with general purpose, water tight or explosion-proof enclosures, and may be mounted in any position. Valves are available in ⅜", ½" and ¾" sizes, all with full flow capacity provided by oversize pressure and exhaust orifices. Standard Bulletin 8316 Valves are suitable for air, gas, oil and water at pressures up to 250 p.s.i.; higher pressures can be handled by modified versions.

New! Catalog No. 202 covers the ASCO line of Solenoid Valves. Write for your copy today.

For Immediate Delivery . . .
World's largest stock of Solenoid Valves. A complete Solenoid Valve Stock List will be sent to you with your copy of Catalog No. 202.



ASCO®

Automatic Switch Co.

50-B Hanover Road, Florham Park, New Jersey • FRontier 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

CIRCLE 16 ON TIME-SAVER CARD

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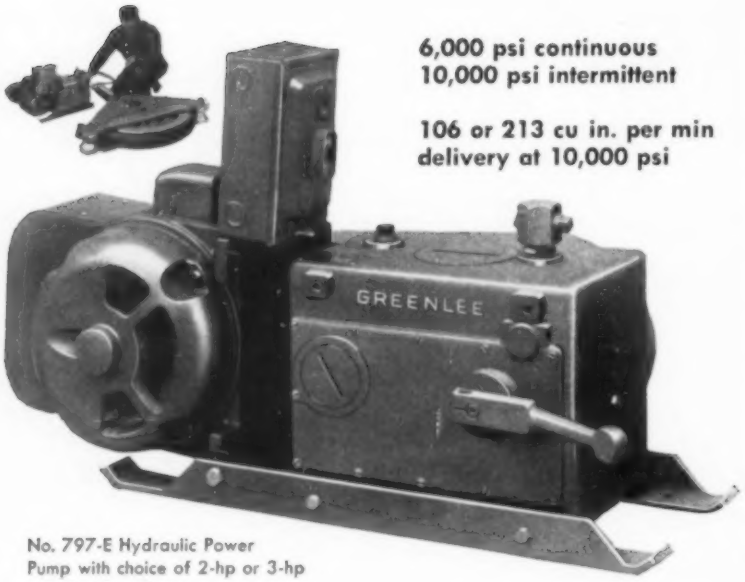


6,000 psi continuous
10,000 psi intermittent

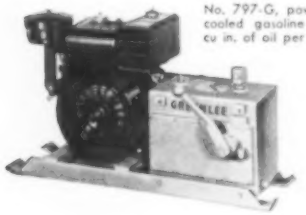
106 or 213 cu in. per min delivery at 10,000 psi

No. 797-E Hydraulic Power Pump with choice of 2-hp or 3-hp a-c electric motor

EXCLUSIVE QUICK APPROACH... AUTOMATIC CHANGE-OVER TO FAST HIGH-POWER DRIVE

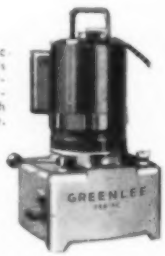
GREENLEE No. 797 Hydraulic Power Pumps readily apply to numerous rams, jacks, presses, and special hydraulic installations where high-speed, high-power operation is an advantage. Exclusive GREENLEE fast-approach feature eliminates nearly all time loss ordinarily accumulating while operators wait for the ram to contact the work! Change-over to drive speed is automatic at 6000 psi for smooth, fast, heavy-duty work. Delivers 106 cu in. of oil per minute at 10,000 psi when equipped with a 2-hp a-c motor — 213 cu in. with 3-hp a-c motor. Three-phase 60-cycle 220/440-volt motors; available gasoline-powered units are described below.

Fast hydraulic return of ram is available in every type GREENLEE power pump! All pumps available for either single-action or two-way-action rams.



No. 797-G, powered by 4½-hp air-cooled gasoline engine, delivers 106 cu in. of oil per minute at 10,000 psi.

No. 798 Portable Hydraulic Power Pumps feature two speeds for fast approach, develop 6000-psi continuous, 10,000-psi intermittent pressure. Equipped with a-c motor or gasoline engine. Easily carried by one man.



No. 768 Fast-Approach High-Pressure Hydraulic Hand Pump develops up to 10,000 psi.

TOOLS FOR CRAFTSMEN
GREENLEE

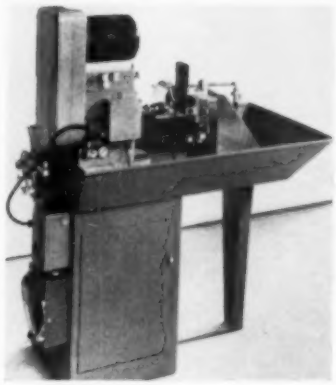
WRITE or attach this page to your letterhead for illustrated data on all these GREENLEE pumps. Our engineering department is equipped to help you on special applications.

GREENLEE TOOL CO., 2450 Herbert Ave., Rockford, Ill.

CIRCLE 58 ON TIME-SAVER CARD

BRIEFS

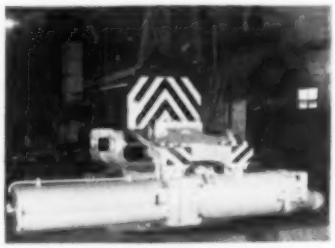
for the efficient operation of hydraulic equipment, and the location of trouble when it occurs. It gives information on preventive maintenance schedules, starting new machines, life of hydraulic oil, and the diagnosis of faults and their correction. Information is given in table and chart form. ▼▼▼



SPINDLE FEED on this drilling and tapping machine is air-cylinder-operated. Speed is controlled by intake and exhaust metering valves supplemented by hydraulic control for break-through. Made by Unimatic Machine Products, Inc., Schiller Park, Ill., the machine will drill and tap to ⅜ in. dia.

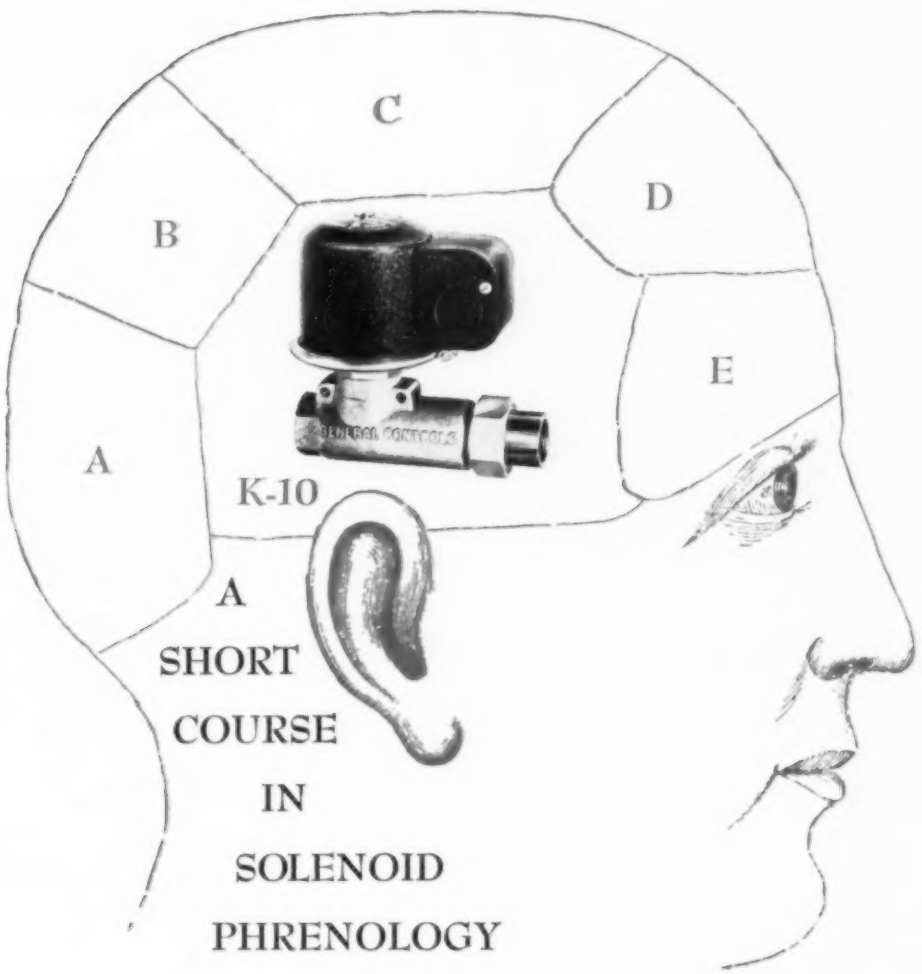
Hydraulic Gun Shoots Clay

Once a blast furnace has been tapped there comes the problem of plugging the hole. In the past this had been done mechanically. Salem-Brosius, Inc., Pittsburgh, Pa. spent three years on design,



construction and test of this hydraulic clay gun. The gun must rotate 180 degrees in a horizontal plane and move up and down to locate the nozzle in the tap hole.

Continued on page 38



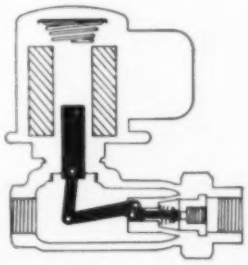
A WORRY. Subject beset by control problem. Knows solenoid valve best for job – but which solenoid? And made by which company? Perplexed, turns problem over to *Division B*...

B CURIOSITY. Who makes the broadest lines of solenoid valves? GENERAL CONTROLS. Single source saves time, subject gets better insight to problems through constant contact with same control specialist. Contented, subject turns to *Division C*...

C MEMORY. Fullest line. Solenoids for oil, gas, water, steam, corrosive fluids, refrigerants. Covers the whole pressure span 0 to 3000 psi in normally-open, normally-closed, shut-off, 3-way and 4-way valves. Direct-acting, lever-acting, pilot (pressure) operated. Valve bodies in cast or forged brass, cast iron, cast steel, cast stainless steel. Coils for temperature extremes, water-proof and explosion-proof requirements. Satisfied, turns complete file to *Division D* for approval...

D REASON. GENERAL CONTROLS makes more solenoid valve types. GENERAL CONTROLS has 42 factory branch offices across the map... for immediate, qualified service. GENERAL CONTROLS has a reputation for quality coupled with a firm understanding of manufacturers' competitive problems. Approving, subject turns to *Division K-10* for support...

K-10 PROOF. The famous lever-action solenoid valve principle was originated by GENERAL CONTROLS over 20 years ago. The K-10 incorporates stainless steel ball and seat for longer life and tighter shut-off. Built-in union connection and conduit junction box speeds easy installation and pipeline removal. Choice of brass, iron, stainless steel. Handles pressures to 1000 psi. In wide use with oil, steam, water and corrosive fluids. K-10 is just one of GENERAL CONTROLS complete line of solenoid valves. Point proved, subject turns project to *Division E*...



ACTION. When it's Solenoid Valves you want, call on the man from GENERAL CONTROLS... automatically puts your WISDOM division to work!

GENERAL CONTROLS
Manufacturers of America's Finest Automatic Controls for Home, Industry and the Military
Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada
Six Plants—42 factory branch offices serving the United States and Canada

CIRCLE 57 ON TIME-SAVER CARD

FULFLO

piston-type oil relief by-pass valves for O.E.M. or replacement

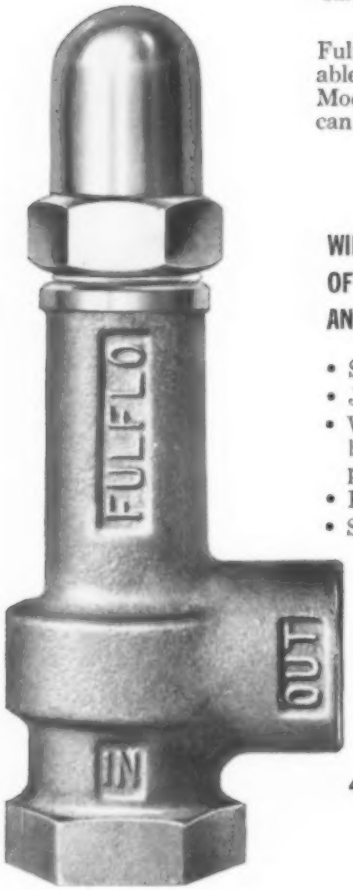
Best Buy because

QUICK DELIVERY

Fulflo stocking policy *and* practice permits quick shipment from stock of most standard types. Shipment is usually made *within 24 hours.*

TECHNICAL SERVICE

Fulflo engineers are ready *and* able to help you with any valve problem. Modified standard or special valves can be provided for any need.



WIDE RANGE OF TYPES AND SIZES

- Standard and flanged models
- Just 6 springs for pressures to 500#
- Wide range of brass, cast iron or steel bodies . . . brass, steel or stainless pistons
- Pipe sizes to 3″
- SPECIALS to your requirements

Write for "Fulflo Valves Mechanical Data Book"

FULFLO

THE FULFLO SPECIALTIES CO., INC.
415 FANCY AVENUE • BLANCHESTER, OHIO

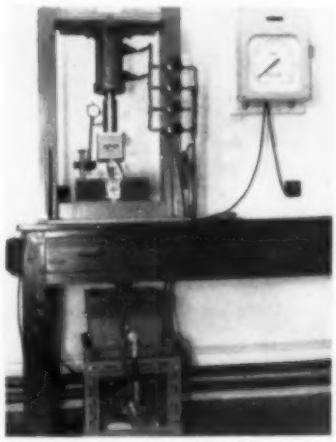
BRIEFS

Then the clay must be forced into the tap hole.

• **Hydraulic System**—A 900 psi system handles the rotation and tilting. Traverse and extrusion are done with a 2500 psi pump. Each circuit has its own reservoir. A 30 hp motor drives the high pressure pump and a 3 hp motor drives the low pressure pump. ▼▼▼

Briefs From Britain

• **Testing safety glass**—A hydraulic testing machine, installed in the Triplex Safety Glass Research Laboratory, will give a uni-

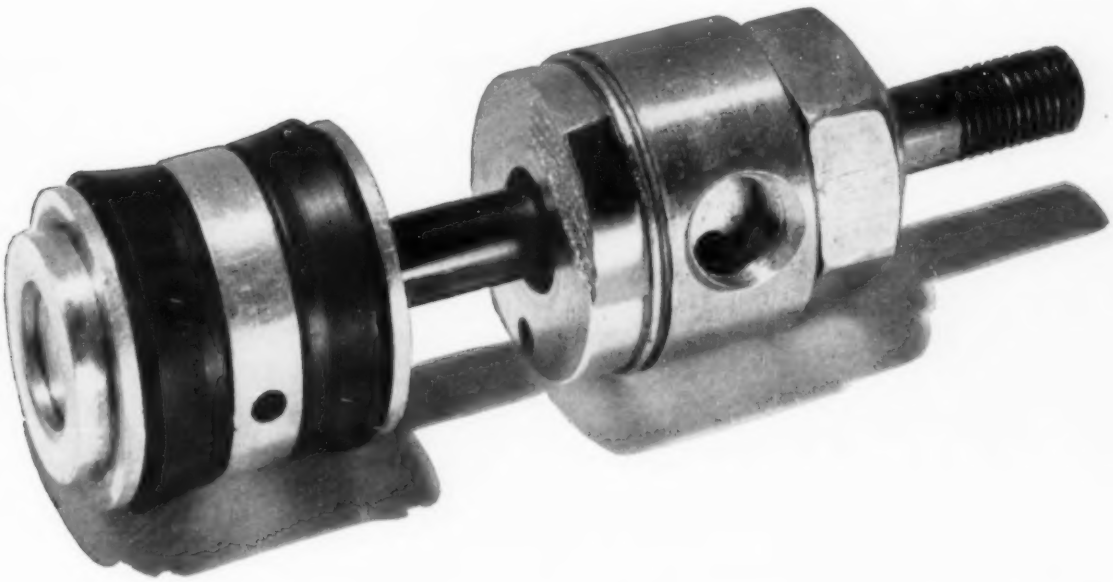


form increase in stress up to 10,000 psi. Built by Keelavite engineers it is used to measure the stress in flexure developed by safety glass at rupture. Deflection is indicated on a micrometer dial gage.

• **What? Hose Fitting**—We've all done some inspecting of nylon

stockings, but since this is an age where everything is automatic,

Continued on page 40



Like NEW—after 1,600,000 Cycles!

. . . due to the right combination of packings and engineering

That's right, 1,600,000 cycles. The picture is about twice actual size, unretouched. The application: a Model 091-D double acting air cylinder produced by Bimba Manufacturing Co., Monee, Illinois.

The designer got excellent results for two reasons. One: he specified and insisted on a close, smooth inside finish. Two: he specified Houghton Vix-Syn "U" Cups.

He knew—as so many engineers are discovering—that Houghton Packings of any standard material—rubber, fabricated rubber, wax or rubber-impregnated leather—will give a bonus in long wear and reliability in correctly designed pneumatic and hydraulic equipment. And he also knew Houghton backs up packings with prompt engineering service when it's needed.

Why not make Houghton your packing headquarters? Don't settle for less than the foremost packing know-how in the business. Specify Houghton packings. Free folder gives engineering features and lists all sizes available. Write E. F. Houghton & Co., 303 West Lehigh Avenue, Philadelphia 33, Pa.

VIX-SYN "U" CUP PACKINGS

. . . products of

E. F. HOUGHTON & CO.

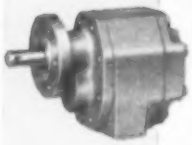
PHILADELPHIA • CHICAGO • DETROIT • SAN FRANCISCO

Ready to give you on-the-job service . . .

CIRCLE 67 ON TIME-SAVER CARD

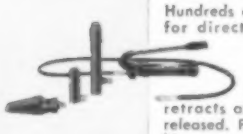
ENGINEERED HYDRAULIC ASSEMBLIES

for all industry...



Engineering to your specifications . . . and for your special problems or Standard hydraulic units as low cost "shelf items"

Large inventories always on hand in a variety of hydraulic motors, pumps, cylinders and control valves. Moderate to large quantities for long runs for maximum high production. Facilities for non-stock items. Ample equipment reserved for short runs.



Push-master Remote Control Single Acting Industrial Jacks

Hundreds of uses in industry for direct push-power for moving, pressing, bending, straightening, lifting. Ram retracts automatically when released. Packed in carrying kits or stands with wide selection of accessory tools.

Push and Pull Remote Control Industrial Jacks

All the advantages of the single-action Jack plus direct push and pull power with one ram. 4, 10, 20 ton capacities. Carrying kits or stands.

HEIN-WERNER Industrial Jacks

Capacities: 1½, 3, 5, 8, 12, 20, 30, 50 and 100 tons. Eight ton jacks and up may be equipped with pressure gauges.

BE PREPARED!

Hein-Werner Industrial

RESCUE KITS

Small cost pays off thousands of times in an industrial accident. Tools clipped in-place for quick easy reach. Quick couplers on extensions save many minutes.

Hein-Werner CORPORATION
WAUKESHA, WISCONSIN

World's Largest Manufacturer of Hydraulic Jacks

CIRCLE 63 ON TIME-SAVER CARD

BRIEFS

Britain has even developed a machine for this.

The stockings are first drawn by hand on to a former which is then expanded by compressed air and rotated for all around inspection. If the stocking is flawless, the operator depresses a foot control valve that releases a blast of air which blows the nylon down a tube running through the center of the former. Another air cylinder controls the position of a chute which delivers the hose into one of several hoppers, according to its grade. Compressors for this installation were built by Hymatic Hydrovane Ltd. ▼▼▼

Compressor Layout Saves Space

The refinery of a large eastern oil company operates an unusual air compressor plant. A duplex system, it consists of eight two-stage rotary air compressors,

hooked up in two's and direct-driven by four 700 hp electric motors.

Ordinarily, each of the 1664-cfm compressors would have its own power source. Here space was

Continued on page 44

BRIEF NOTES

AVTOMATIKA I TELEMEKHANIKA . . . looks like something that got past the proof reader but it's the name of a Soviet Automatic Control Journal that is being translated into english and available at low-cost subscription rates. Translation is made by Massachusetts Institute of Technology. Circulation will be handled by the Instrument Society of America.

ADVENTURE IN RUBBERLAND . . . is the title of a 16-page folder available from Minnesota Rubber Co., Minneapolis, Minn. Printed in four colors it takes the reader on a trip through the company's complete manufacturing and engineering facilities.

NFPA STAFF ASSISTANT . . . Dudley A. Pease who has been on the faculty of the Henry Ford Community College in charge of instruction in hydraulics and pneumatics has been appointed to the board of directors of the NFPA. He was selected by a special committee which met in Cleveland on July 20th.

LETTER SYMBOLS FOR HYDRAULICS . . . Members of the ASA Y10 committee have approved a new set of letter symbols for hydraulics. The symbols are available in a 12-page booklet published by the ASME. It is their aim that these symbols will receive general acceptance of industry.

RUGGED PLASTIC . . . A phenolic resin called Plyophen 5900 developed by Reichold Chemicals, Inc., can be laminated with glass, cloth or asbestos and will withstand heat up to 500 F for 100 hours or more. It resists most solvents, hydraulic oil, and hot gas erosion. It will be used for missile and rocket nose-cone sections and skin strengtheners.

BUSINESS BRIEFS

NET INCOME UP . . . for the second quarter of 1958 was reported by Westinghouse Air Brake Co., Pittsburgh, Pa. Net income rose to $2,611,134 from first quarter earnings of $2,301,276.

EARNINGS HIT ALL-TIME HIGH . . . net earnings of Parker-Hannifin Corp., Cleveland, Ohio, for its fiscal year ending June 30, 1958, totaled $2,054,996, or $3.36 per share for the best year in the company's history. Total sales for the twelve months were $34,947,153 compared to $28,349,060 in the preceding fiscal year.

GREER—Headquarters for All Types of Accumulators:
SEPARATOR • NON-SEPARATOR
SPRING LOADED • WEIGHT LOADED

NOW-

Make GREER Your Single-Source for All Accumulators!

No matter what your accumulator requirements may be, Greer can help you choose the right one to do the job best—because Greer is the only company that makes all types.

Greer's experience and technical know-how in the application of accumulators to aircraft, missiles and industrial equipment is unmatched in the field.

Let a Greer representative show you how Greer Accumulators simplify circuits, reduce size, weight and cost of equipment, and improve performance with complete reliability. Write or call Greer without obligation for immediate assistance.

FREE! GREER ACCUMULATOR DATA FILE. Complete information with diagrams on standard and special accumulators for aircraft, missiles and industrial equipment. Details 9 ways to use an accumulator effectively, plus other important data. A must for engineers and manufacturers.

NEW! PISTON ACCUMULATORS

Greer introduces a complete line of competitively priced standard Piston Accumulators available for prompt delivery. Special design and construction gives extra safety because it is impossible to disassemble the accumulator while it contains a precharge.

Wherever standard piston accumulator performance is desired, specify the Greer Piston Accumulator for all your industrial applications.

Specifications: 3000 psi operation. 9 models from 10 cu. in. to 2250 cu. in. oil capacities. Operating temperature range —65° to +425°F. Available for use with most types of fluids, gases, etc., high or low temperatures, as specified.

A COMPLETE RANGE OF SIZES IN BOTH TYPES

BLADDER ACCUMULATORS

Unmatched Reliability and Versatility PLUS ONE YEAR WARRANTY!*

The famous Greer Bladder Accumulator is unmatched for all-around dependability and long-run economy. Proof of utmost reliability and acceptance is in its diversified usage: planes, ships, missiles, submarines, buses, construction machines, pipelines—and many other industries.

Greer Bladder Accumulators meet all J.I.C. and I.C.C. safety standards and are approved for installations under all applicable state, municipal and industrial safety codes. Also easiest to install with lowest maintenance cost.

Specifications: 8 models from 1.5 cu. in. to 2080 cu. in. oil capacities. Two operating pressure ranges: 0-3000 psi and 0-6000 psi. High and low operating temperature for use with most types of fluids, gases, etc.

*See your Greer representative for details on this exclusive warranty.

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When it's a question of
HYDRAULICS
it pays to consult
POWER JACKS

PUMPS and JACKS

Hand Operated Pump

Motorized Pump for low voltage or mains supplies

Swash Plate Pump for direct or pulley drive.

Retraction Jack

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Double Acting Jack (Extension and Retraction)

BRING YOUR HYDRAULIC PROBLEMS TO US-

Our Technical Service is at your disposal

VALVES

2 way or 4 way valves for Hand Operated Pump

Solenoid Valves push open or push closed

Sensitive Lift Valve for hand or foot operation

3 or 4 way open centre valve for motorized equipment

POWER JACKS LIMITED

Send for illustrated technical brochure. Publication No. F/223

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A MEMBER OF THE NEWTON GROUP

CIRCLE 99 ON TIME-SAVER CARD

Atlantic Tool & Die Co., Elizabeth, New Jersey

Air gage tracer lathe puts .001" tolerance burden on Cities Service Hydraulic Oil!

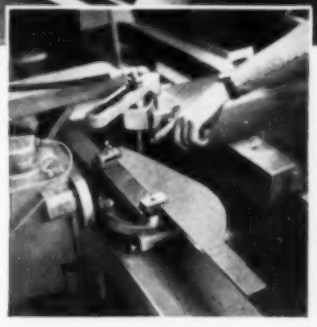
Used for straight or contour turning, boring, and facing, this air gage tracer lathe at Atlantic Tool & Die Company really pours the punishment on Cities Service Hydraulic Oil.

For against the force of the lathe itself, the hydraulic system must hold the cutting tool rigid...must maintain tolerances of one thousandth of an inch!

Carefully chosen for its unusual stability, Cities Service Hydraulic Oil is more than equal to this punishment. Where other oils might fail, Pacemaker 150-T gives consistently flawless service—thanks to its high viscosity index and superior fortification against oxidation, corrosion and rust.

Says Atlantic Tool & Die: "The performance we get from Cities Service Pacemaker 150-T is the kind we've gotten from all Cities Service products for the past 11 years. In selecting cutting oils, hydraulic oils or any lubricant, we've found the surest way to improved lubrication is the special knowledge of our Cities Service Lubrication Engineer. He's always available, always eager to help. We rely on him."

If you're unable to say the same for your lubrication problems, talk with a nearby Cities Service Lubrication Engineer. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, New York.



This template determines the shape of the surface to be cut. Air-actuated stylus rides along template and transmits its movements to the hydraulic cutting arm which duplicates them exactly.

Cutting arm is hydraulically operated and the oil used in the system is Cities Service Pacemaker-T. Against the force of the lathe itself, it must maintain tolerances of .001".

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

CIRCLE 31 ON TIME-SAVER CARD

Flexon

the first name in flexible metal hose and fittings

Proved in use for over 56 years

FLEXON hose assemblies are available in the widest range of standard and special types to meet all your metal hose needs.

FLEXON corrugated or convoluted hose is available in a variety of types and materials . . . stainless steel, steel, bronze, and alloys.

FLEXON fittings are offered in a complete selection for use with all types of Flexon metal hose for any services.

When you specify FLEXON metal hose, you specify top performance. 56 years of user satisfaction have made FLEXON the first name in the field.

Modern volume-production facilities . . . advanced quality control methods . . . an intensive research program . . . all these combine to bring you superior performance and value. And back of it all is the "know-how" only long experience can bring.

A complete line of FLEXON metal hose and fittings is available for your fluid power needs. Find out how FLEXON can help you. For specific recommendations, send an outline of your requirements.

Flexonics *Corporation* MH-42

® Flexon identifies products of Flexonics Corporation that have served industry for over 56 years.

1385 S. Third Avenue • Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Manufacturers of metal and rubber hose, expansion joints, metallic bellows and aircraft components.

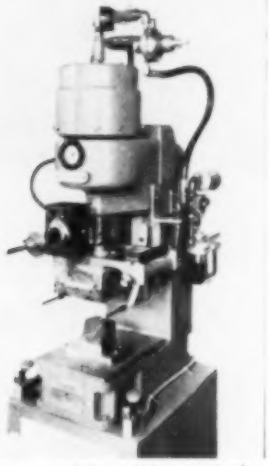
CIRCLE 48 ON TIME-SAVER CARD

BRIEFS

saved by connecting two units to a common motor. Supplying the air load of 13,200 cfm, the Fuller Co., Catasauqua, Pa., compressors deliver air at 115 psi for tools, machinery, air lines and other pneumatic uses. Operation is automatic and the units are lubricated by a forced-feed system. ▼▼▼

Quiet Air For Hot Stamping

Provided with a muffler which eliminates air noise, the Acromark Company, Elizabeth, N. J. has built this model, No. 250, hot

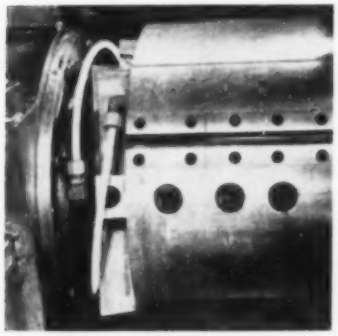


stamping machine. The unit includes a powerful air pressure system, automatic cycling for automatic operation and a pressure cycle control unit. The press is adaptable for hot stamping almost any product of plastic or painted metal, wood or other material that can go within a 6 x 8 in area. Operating speeds permit up to 1000 hot stamped pieces per hour. ▼▼▼

Polyamide Tubing Resists Abrasion

Hydraulic lines of polyamide tubing have had long life on this rolling mill winding reel. The mill processes high-carbon spring steel. Steel strip leaving the mill is clamped in a hydraulically-operat-

ed gripper and wound around a 16-in. dia. reel. A 50-in. length of flexible tubing takes the hydraulic oil from the pressure



source behind the back plate to the actuator in the reel.

During winding, the tube, reel, and face plate rotate causing abrasion when the tubing flaps between the reel and the plate.

The $\frac{3}{8}$ in. tubing made by The Polymer Corp. of Penna., Reading, Pa. worked very well under the 600 psi, 150 F conditions. The tubing has a short-time burst rating of 2500 psi. ▼▼▼

Elevator Truck Saves Muscle

Hydraulic cylinders raise and lower this truck body so that loading and unloading can be done at any level. This makes it possible to load at a warehouse shipping platform and unload at curb level. Made by the Thompson Trailer Co., a subsidiary of General American Transportation Corp., Pikesville, Md., the truck has no rear

axle or drive shaft. The rear wheels are attached to hydraulic levers which are in a diagonal position when the trailer is up and lowered to a horizontal position when it comes down. The front moves up and down in a vertical guide mounted on the truck cab. Called the Leveloder the truck has a front wheel drive. ▼▼▼

Flexon

a new name in hydraulic hose assemblies and fittings

Backed by over 56 years experience!

The name FLEXON—long a symbol of quality in flexible connections—now identifies a complete line of hydraulic hose and fittings.

Built into this line is the "know-how" gained through 56 years of manufacturing experience . . . 36 years of hydraulic hose experience. Like all products bearing the FLEXON label, these fluid power products are backed by continuous research and rigid quality control . . . and are volume-produced with modern facilities . . . to give you performance and value second to none.

Find out how FLEXON craftsmanship can add dependability to your fluid power applications. For specific recommendations, send an outline of your requirements.

FLEXON rubber hose is available in a wide range of types and sizes for every fluid power application.

FLEXON complete hose assemblies are furnished with a broad choice of standard and special fittings for every pressure range.

FLEXON fittings are available in reusable, pressed on, clamp, flange, S.A.E., and special types, to meet every need.

Flexonics Corporation RH-12

Mr. Flexon identifies products of Flexonics Corporation that have served industry for over 56 years.

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Manufacturers of metal and rubber hose, expansion joints, metallic bellows and aircraft components.

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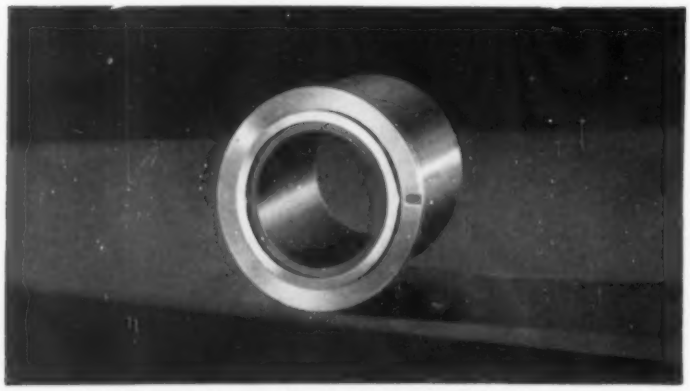
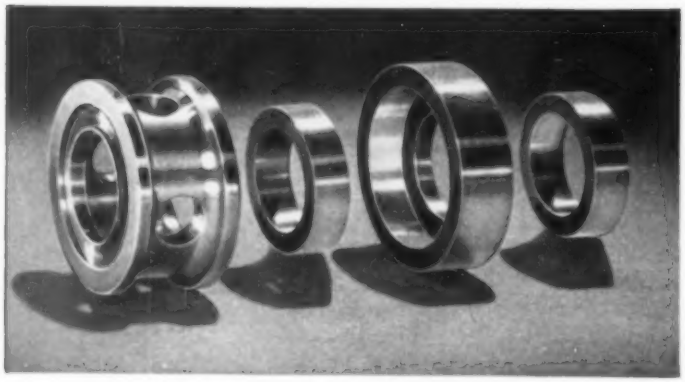


SINGLE BUSHING TYPE Floating Ring Seal

Seal Any Medium—Even Corrosive Media ... with Koppers Floating Ring Seal

MULTIPLE RING TYPE Floating Ring Seal (assembled)



FLOATING RING SEAL Basic Elements: Lantern Ring, Floating Ring, and Spacer Diaphragm. As sealing needs dictate, floating rings and spacer diaphragms are added. Seals are carbon, plastics, ceramics or steel, as applications require.

The Only "No Maintenance" Seal for Rotating, Oscillating and Reciprocating Motion

Koppers' precise, efficient Floating Ring Seal assures long seal life, low leakage, reduced wear, less power consumption, and decreased operating costs.

It seals at high temperatures and at pressures up to, and for some conditions even above, 2000 psi. Inspection has shown that after 10,000 hours of operation, ring and spindle wear can be negligible. For water at 500° F. and 1200 psig with a ⅝" spindle, leakage is only one to two pounds per hour. Frictional power requirements are virtually zero, and Koppers' design reduces radial frictional restraint. Sealing members adapt to changes in the shaft's position.

Applicable to valve spindles, pumps, atomic reactor spindles and many other similar installations, Koppers Floating Ring Seal gives efficient, low-cost service for the sealing of all types of fluids under widely varying conditions of temperature and pressure.

For additional information, write to: KOPPERS COMPANY, INC., Piston Ring and Seal Department, 1510 Hamburg Street, Baltimore 3, Maryland.

KOPPERS

MECHANICAL SHAFT SEALS

Engineered Products sold with *Service*

CIRCLE 78 ON TIME-SAVER CARD

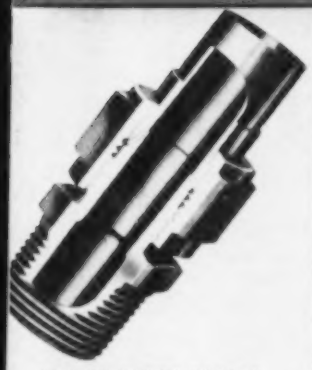
CIRCLE 5 →

AFCO

37° FLARED "J.I.C." and FLARELESS TUBE • PIPE and HOSE

FITTINGS

STEEL • ALUMINUM ALLOY • BRASS • STAINLESS STEEL



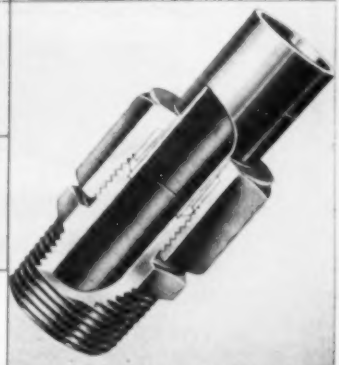
37 FLARED "J.I.C."

FLARED TUBE FITTINGS and PIPE FITTINGS

J 815 TUBE UNION	J 815-X-X REDUCER UNION						
J 816 MALE CONNECTOR	J 854 FEMALE CONNECTOR	J 821 TUBE ELBOW	J 822 MALE ELBOW	J 877 LONG MALE ELBOW	J 878 EXTRA LONG MALE ELBOW		
J 823 MALE ELBOW 45	J 855 FEMALE ELBOW	J 824 TUBE TEE	J 825 MALE SIDE TEE	J 826 MALE RUN TEE	J 856 FEMALE SIDE TEE		
J 857 FEMALE RUN TEE	J 827 TUBE CROSS	J 832 BULKHEAD UNION	J 833 BULKHEAD ELBOW	J 834 BULKHEAD TEE	J 837 45 BULKHEAD ELBOW	J 806 TUBE PLUG—FLARED	J 860 TUBE END REDUCER
J 818 TUBE NUT	J 819 TUBE SLEEVE	J 820 TUBE CAP—FLARED	J 924 BULKHEAD LOCKNUT	910 PIPE CONNECTOR	911 PIPE NIPPLE	912 REDUCING BUSHING	913 SQUARE HEAD PLUG
914 90 STREET ELBOW	915 45 STREET ELBOW	916 PIPE ELBOW	917 PIPE TEE	918 PIPE CROSS	932 HOLLOW HEX PLUG	933 HEX HEAD PLUG	840 HOSE NIPPLE

FLARELESS TUBE FITTINGS

F 815 TUBE UNION	F 815-X-X TUBE UNION REDUCER	842 90 HOSE ELBOW	844 45 HOSE ELBOW				
F 816 MALE CONNECTOR	F 854 FEMALE CONNECTOR	F 821 TUBE UNION ELBOW	F 822 90 MALE ELBOW	F 823 45 MALE ELBOW	F 855 FEMALE ELBOW	F 824 TUBE TEE	F 825 MALE SIDE TEE
F 826 MALE RUN TEE	F 856 FEMALE SIDE TEE	F 857 FEMALE RUN TEE	F 827 TUBE CROSS	F 832 BULKHEAD UNION	F 833 90 BULKHEAD ELBOW		
F 834 BULKHEAD TEE	F 837 45 BULKHEAD ELBOW	F 860 TUBE END REDUCER	F 818 TUBE NUT	F 819 TUBE SLEEVE	F 924 BULKHEAD LOCKNUT		
F 929 TUBE CAP	F 806 TUBE PLUG						



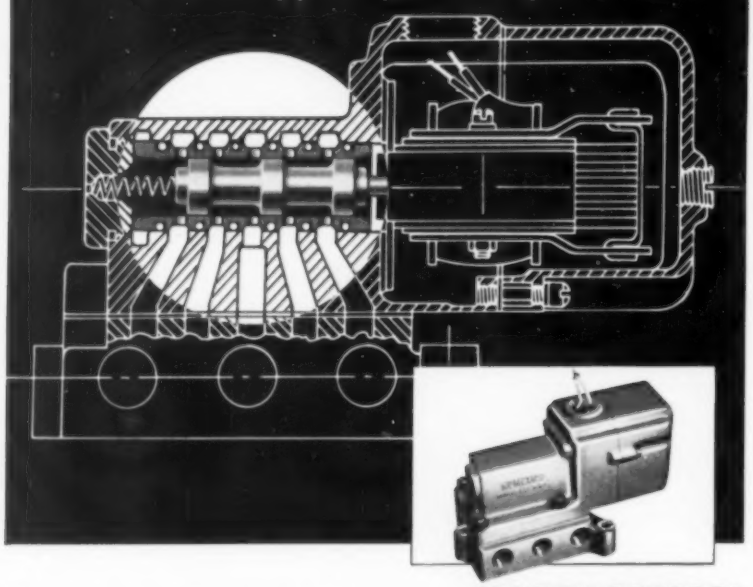
FLARELESS

AFCO FITTING CO.

5300 Harvard Avenue Cleveland 5, Ohio

SEND FOR CATALOG ON THE COMPLETE LINE OF— **AFCO INDUSTRIAL FITTINGS**

It's the air valve with the floating sleeve-lapped spool design



Starts every time—INSTANTLY!

no sticking, lubrication or dirt problems

Familiar with those Monday morning epidemics of sticking valves? Never happens with Numatics air valves . . . not even after *months* of idleness. Because the patented floating sleeve-lapped spool design eliminates the major cause of sticking . . . moving elastic seals. Sealing is accomplished, instead, by the precision finish and close tolerance between spool and sleeve.

And no-stick, no-leak sealing is just one advantage of Numatics valves. Lubrication is no problem, for a Numatics valve is impervious to oil additives. They'll operate on *any* standard lubricant . . . or, they'll run dry if the application requires it. Dirt is no problem, either, because the file hard, razor sharp spool lands and orifice edges chop dirt particles to a fineness that permits passage through the valve without the slightest damage. What's it all add up to? . . . a valve that's more *reliable* and trouble-free, a valve that will last longer than any air valve now available. For complete details send for your copy of catalog #158.

NUMATICS leads the way in manifolds too

For greater efficiency, lower cost, streamline your valve installations with Numatics multiple mount manifolds. Three types available . . . individual or common exhaust and conduit . . . in 2 to 6 stations, 4 pipe sizes. SA Valves mount interchangeably, too!

NUMATICS, Inc. HIGHLAND, MICHIGAN

SALES REPRESENTATIVES FROM COAST TO COAST

CIRCLE 90 ON TIME-SAVER CARD

FUTURE EVENTS

October 13-15: ASME-ASLE Lubrication Conference, Statler Hotel, Los Angeles, Calif. Papers will be presented on lubrication, wear, and high temperature. For further information contact R. B. Purdy, 150 East 42nd St., New York City.

October 13-15: 10th National Machine Tool Conference, sponsored by the American Institute of Electrical Engineers. Statler Hilton Hotel, Hartford, Conn.

October 14-16: Society of Industrial Packaging and Material Handling Engineers, National Exposition, The Coliseum, Chi-Ill.

October 16-17: NCIH 14th Annual Meeting. Sherman Hotel, Chicago, Ill. For complete information write Raymond D. Meade, Conference Secretary, Illinois Institute of Technology, Chicago, Ill.

October 27-31: American Society for Metals, National Metal Exposition and Congress. Public Auditorium, Cleveland, Ohio.

November 3-5: National Fluid Power Association fall meeting, Drake Hotel, Chicago, Ill. For information write Barret Rogers, Executive Secretary, 1618 Orrington, Evanston, Ill.

December 4-5: Industrial Engineering Conference, Illinois Institute of Technology, Chicago, Ill.

January 12-16, 1959: SAE Annual Meeting, and Engineering Display. Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

March 31-April 3: SAE National Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N. Y. ▼▼▼

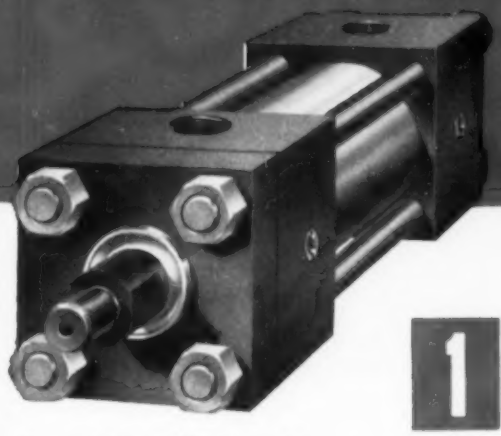
CIRCLE 86 →

SEAL FAILURE MEANS CYLINDER FAILURE

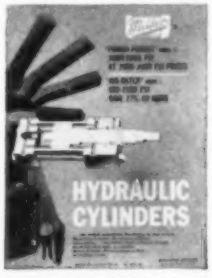
Petroleum base, fire-resistant and special hydraulic fluids cause distortion and rapid deterioration of the seals currently used in many hydraulic cylinders, resulting in costly repairs and cylinder failure. (Seals made of synthetic rubber are not compatible with even 50% of available commercial petroleum base fluids and the life of such seals is materially reduced at operating temperatures above 150° F.)

Specify Miller HYDRAULIC CYLINDERS

FOR UNLIMITED SEAL LIFE!



Request Bulletin JH-104N for complete data plus helpful charts on column strength, cylinder forces, factors of safety, acceleration, pipe pressure losses, etc.



1 ALL TEFLON* SEALED Against External Leakage

TEFLON is impervious to all known hydraulic fluids, including all fire-resistant and special types – and withstands temperatures from –100°F. to plus 450°F.

TEFLON SHEF SEAL AT TUBING ENDS

No blind assembly. Is

Shear-proof
Heat-proof
Extrusion-proof
Fluid-proof

TEFLON SEALS ON PISTON ROD AND BUSHING

Teflon rod flange seal requires no adjustment. Teflon bushing seal is shearproof. Teflon wiper keeps dirt out.

TEFLON SEALS ON BALL CHECK AND ADJUSTING SCREW

Non-protruding, self-locking, cushion adjusting screw interchangeable with ball check for easy access.

2 CASE-HARDENED CHROME PLATED PISTON RODS

Provide foolproof protection against seal failures resulting from rod damage. The Miller case-hardened rods (50-54 Rockwell C) give practically complete immunity to damage from hammer blows, wrench-dropping, mishandling, etc. The hard chrome plating over the case-hardened rods protects against scratch-damage and rust.

AVAILABLE IN TWO TOP QUALITY LINES

JOB-RATED
Model "J"

PRICE SAVINGS OF 27% OR MORE!

19 mounting styles, all strokes, cushioned and non-cushioned. Large selection for immediate shipment.

BORE	SEVERE OPERATING CONDITIONS	MODERATE OPERATING CONDITIONS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

POWER-PACKED
Model "H"

50% More Power Per Cylinder Dollar!

For

3,000-5,000 P.S.I.

1½" through 12" bores, 17 mounting styles, strokes up to 22 ft., cushioned and non-cushioned. Large selection for immediate delivery.

*DuPont trademark for its tetrafluoroethyline resin

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL

Teflon Pressure Energized

Hydraulic Cylinder Tubing End Seal

PAT. APPLIED FOR

OTHER MILLER QUALITY FEATURES

- Solid Steel Heads, Caps and Mountings.
- Precision-Honed Barrels.
- Rust-Resistant Coating on All Non-Wearing Surfaces.
- Space-Saving "Square" Design.

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

2008 N. Hawthorne Ave., Melrose Park, Illinois

AIR AND HYDRAULIC CYLINDERS · ACCUMULATORS
COUNTERBALANCE CYLINDERS · BOOSTERS

PUROLATOR FILTERS FOR THE PROTECTION OF HYDRAULIC CIRCUITS

G-200M Aircraft Restrictor Filter two-way for hydraulic oil systems metal element

PR 301 ½ GPM line type hydraulic oil filter Micronic element

PR 362 3 CFM in-line vent type Micronic element

G 200 series in-line two-way restrictor filter Metal element, internal connections

PR 312 12 GPM line type filter Micronic element

PR 412-8 12 GPM line type filter Military approval

G-187 3 GPM in-line hydraulic oil filter Metal element

P 32-28 Low pressure, high flow hydraulic oil filter

Effective filtration is essential for optimum performance in hydraulic circuits. To keep a system clean and functioning properly, it is important that the filter be designed specifically to meet the requirements of the job.

Purolator's complete line of filters for hydraulic systems includes models for every set of operating conditions likely to be encountered. A few are shown here; there are many more standard models from which to choose. If your application requires a special filter, Purolator will design and build it. Let Purolator work on your toughest filtration problem.

Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

Rahway, New Jersey and Toronto, Ontario, Canada

CIRCLE 100 ON TIME-SAVER CARD

Tubing End Seal
PAT. APPLIED FOR

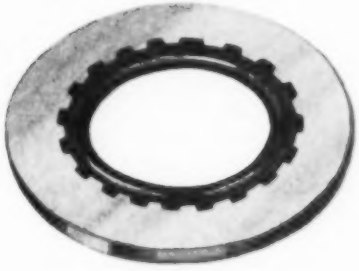
• Space-Saving "Square" Design.

COUNTERBALANCE CYLINDERS • BOOSTERS

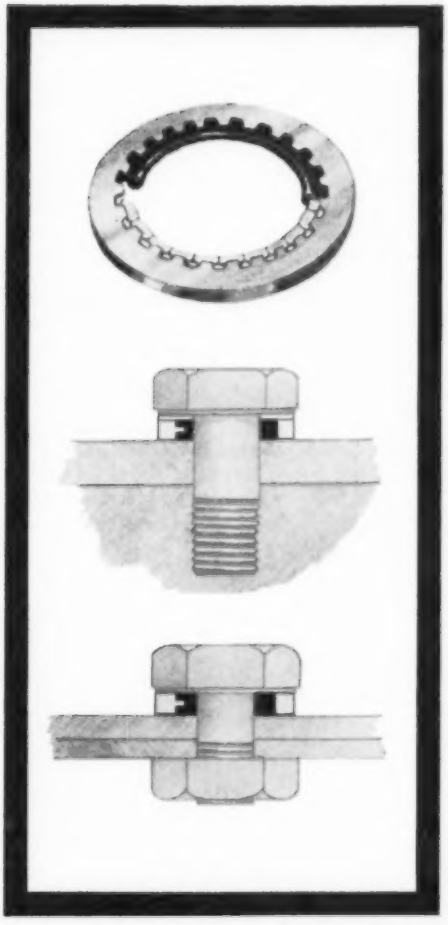
FOR SEALING.

NOW IT COSTS NO MORE

FOR THE SUPERIORITY OF



Stat-O-Seal®



Only Stat-O-Seals offer safe, sure, effective sealing using the principle of controlled confinement of the seal plus the advantages of *mechanical* "bonding".

This means they will not "twist" in installing and there is no chemical bonding agent that can be attacked by corrosive fluids. Stat-O-Seals feature:

- Metal to metal contact of faying surfaces
- Quick, visual inspection
- Easy, one piece, "twist-free" assembly
- Re-useability
- O-ring style configuration for versatility and freedom from easy damage
- Sure sealing from high vacuum to 20,000 PSI
- Standard sizes for bolts and nuts from −6 to 2" and types to seal almost any fluid at temperature ranges from −85° to +360°F.

Stat-O-Seals have been proven in thousands of vital installations and now they cost no more than ordinary seals for similar purposes.

If your product and designs require seals, why not find out how Stat-O-Seals can do a better job for you, too.

by the makers of Gask-O-Seal *and Met-O-Seal*

Parker
SEAL COMPANY*
CULVER CITY, CALIF. • CLEVELAND, 12, OHIO
A DIVISION OF Parker Hannifin CORPORATION

**Formerly Franklin C. Wolfe Co. and Parker Rubber Division*

CIRCLE 94 ON TIME-SAVER CARD

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

PUMP AND MOTOR . . . for small mobile hoists

Designation: Powermite

Features: Custom engineered with specially designed 12-v electric motor and rotary gear pump. Unit is compact 3 3/16 in. dia by 7 5/16 in. long. Rated at 30 cu in. per min at 500 psi. Motor rating $\frac{1}{8}$ hp. Uses 10-W oil for hydraulic fluid. Will operate at temperatures to 200 F. Company will build similar pumps to customers' specifications.

Tuthill Pump Co.
Chicago, Ill.

CIRCLE 300 ON TIME-SAVER CARD

AIR BLEED-OFF VALVE . . . for oil circuits is automatic

Operation: Installed in the pump discharge line with a tee connection, ahead of all other components. Stays open as long as system pressure is low and lets air flow to tank. First surge of hydraulic fluid automatically closes valve. It remains closed until the pressure drops.

Application: In hydraulic systems where pump primes against pressure in a blocked line.

Specifications: For pressures to 5000 psi. Size, $2\frac{5}{8}$ by 1 in. hex, $\frac{1}{4}$ NPT of 9/16- 18 straight threads.

Denison Engineering Div.
American Brake Shoe Co.
Columbus, Ohio

CIRCLE 301 ON TIME-SAVER CARD

HYDRAULIC CYLINDERS . . . for 350 psi pressure

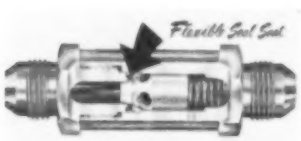
Features: Leakproof O-ring piston seal between two double-acting piston rings. Cast steel mounts are integral with head and rod caps. Pipe ports can be rotated 360 degrees. Cartridge type rod bearing is Meehanite. Packing is spring-loaded V-type on rod and gland.

Specifications: Bores $1\frac{1}{2}$ to 8 in. Strokes to 18 ft. Cushioned or non-cushioned, with no increase in length for cushioned models.

Carter Controls, Inc.
Lansing, Mich.

CIRCLE 302 ON TIME-SAVER CARD

CHECK VALVES . . . have flexible seat for tight sealing



Features: For hydraulic or pneumatic service. Soft seat gives leakproof seal at low pressures. Low pressure drop with reverse flow. Will not vibrate or chatter. Will handle dirt without damage to seat.

Specifications: For working pressures to 3000 psi. Temperatures —40 to 280 F. Made of aluminum, brass, steel, and stainless steel. Sizes $\frac{1}{4}$ to 1 in. NPT and JIC straight thread.

Kepner Products Co.
Summit, Ill.

CIRCLE 303 ON TIME-SAVER CARD

Continued on page 54

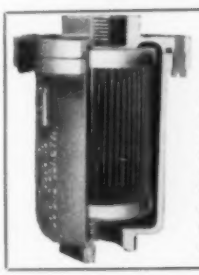
MARVEL Synclinal FILTERS

Answer DESIGNERS' S.O.S.

For Dependable Protection on all Hydraulic and other Low Pressure Systems

Simple, Balanced Design . . . is the answer to the growing preference for MARVEL Synclinal FILTERS. Designers are specifying Marvel Synclinal Filters to assure minimum maintenance and maximum protection. Results show Marvel Synclinal Filters superiority in maintaining the greatest degree of cleanliness of liquids in all hydraulic and low pressure systems with minimum downtime. Furthermore, when filter servicing is necessary, Marvels can be easily disassembled, cleaned and reassembled by any workman in a matter of minutes. Line types operate in any position and may be serviced without disturbing pipe connections.

Again and again, Marvel Synclinal Filters have demonstrated they meet all requirements of the most exacting users, that today—OVER 800 ORIGINAL EQUIPMENT MANUFACTURERS install Marvel Synclinal Filters as standard equipment!



IN-LINE FILTER

Handles up to 25 G.P.M. of hydraulic oil at very low pressure drop. Monel wire cloth filtering media is available in mesh sizes from 30 to 100. Cartridge is easily removed for cleaning.

MEET J. I. C. STANDARDS

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

Catalogs containing complete data available on request.

IMMEDIATE DELIVERY

For further information, write, wire, phone or use coupon below

MARVEL ENGINEERING COMPANY
7227 N. HAMLIN AVE.,
CHICAGO 45, ILLINOIS
Phone: JUNIPER 8-6023

Without obligation, please send me complete data on Marvel Filters, as indicated: (AH-10)

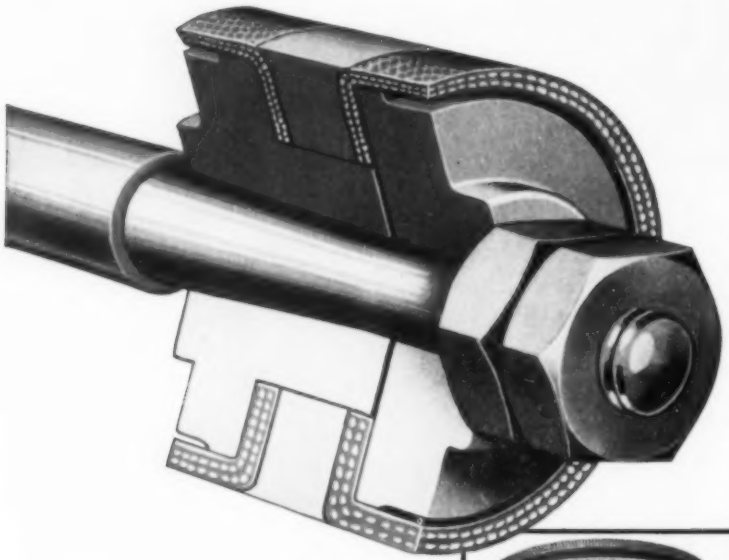
- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name _____ Title _____

Company _____

Address _____

City _____ State _____



WHY PUMCUPS MAKE A DIFFERENCE

Darcova Pumcup

Darcova 45° Bevel Type Pumcup

- **in reciprocating pumps**
- **in air and hydraulic cylinders**

With Darcova Pumcups in your cylinders, there's less fluid slippage. High volumetric efficiency is maintained and Pumcups outlast other packings at least 3 to 1! There's less down-time! Lower power cost! Smoother operation! Less maintenance and replacement!

Longer life is the result of truly advanced cup engineering, including 100% nylon composition, plus a choice of types, textures and precision sizes to exactly match fluid, cylinder, pressure and temperature conditions.

These same factors contribute to prolonged high efficiency by permitting full advantage of the "cup principle". Thus fluid pressure always keeps Pumcups snug against cylinder wall, despite eventual wear, while the total frictional load is minimized.

Send for Bulletin 5503. It will give you *all* the facts.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

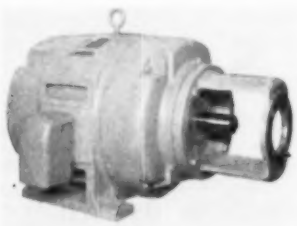
CIRCLE 39 ON TIME-SAVER CARD

NEW PRODUCTS

ELECTRIC MOTOR ADAPTER
. . . for hydraulic pumps

Features: Fits on the end shield of the company's Tri-Clad ac motors. Pump is flange-mounted directly on the motor. Open construction eliminates internal splines. Adapter size varies with motor hp.

Specifications: Motors are made



from 7½ to 125 hp and speeds from 600 to 3600 rpm. Double-ended ventilation. Forged eye-bolt for easy handling.

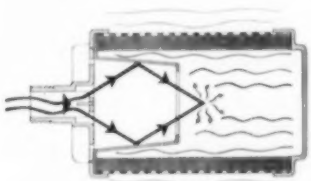
General Electric Co.
Schenectady, N. Y.

CIRCLE 304 ON TIME-SAVER CARD

AIR MUFFLER
. . . is efficient

Designation: M-Series Automuffler

Features: Uses principle of canceling equal and opposite forces. Air entering the muffler is broken up

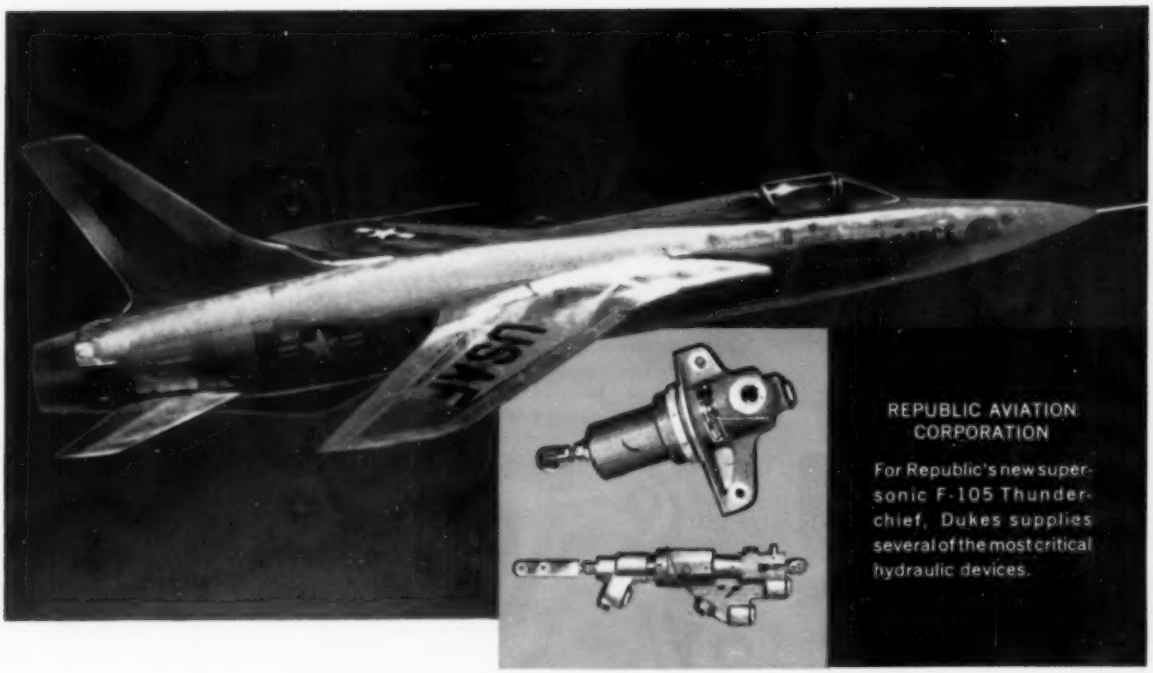


into many waves parabolically reflected back into each other. Collision of these forces cancels out the noise. A radial disseminator exhausts the low-velocity air to atmosphere. Air is diffused at a ration of 60 to 1.

Allied Witan Co.
Cleveland, Ohio

CIRCLE 305 ON TIME-SAVER CARD

Continued on page 56



REPUBLIC AVIATION CORPORATION

For Republic's new supersonic F-105 Thunderchief, Dukes supplies several of the most critical hydraulic devices.

When low cost is important, and quality essential . . .

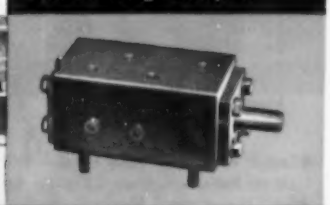
Let Dukes quote on your hydraulic "specials"

Custom-made to specifications furnished, Dukes cylinders and valves are helping build dependability into these and many other trusted products. Let us prove that you can get the quality and delivery you want at the lowest possible price—from Dukes.

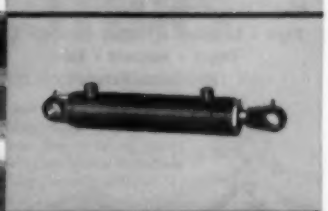
Send for complete new catalog on standard valves

THE ELGIN CORP.

This servo valve is just one of the many Dukes valves incorporated in the new Elgin Street King sweeper.



JOHN DEERE



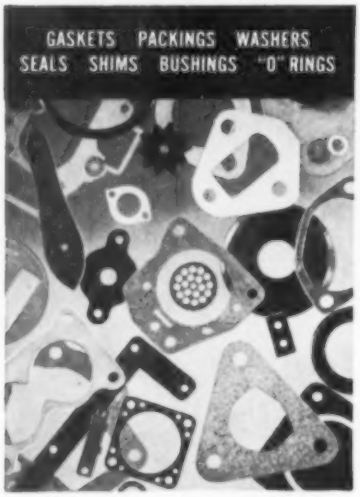
John Deere loaders are built for reliability — Dukes manufactures the Super Duty cylinders for them.

DUKES HYDRAULICS

Dukes Company Inc. • 3999 N. 25th Avenue • Schiller Park, Ill. • A Chicago Suburb

CIRCLE 44 ON TIME-SAVER CARD

We fabricate in more than 200 different materials*



If it's a problem of the right material for the job—at the right price—Auburn is sure to have the perfect solution among the wide range of materials in which we work.

Put our 87 years experience to work for you—Auburn's engineers are tops in their field in designing and fabricating precision sealing devices. Their know-how is at your command. "O" Rings are a speciality with us.

***Leather • Asbestos • Nylon • Vinyl • Teflon Silicone Rubber • Neoprene • Rubber • Cork Fibre • Compositions • Phenolics • Cloth • Felt Paper • Cardboard • Plastics • Brass • Steel Copper • Aluminum • Kel-F Other Special Materials**

Send us your specifications or blueprints. You'll receive prompt quotations and recommendations without obligations.

AUBURN
MANUFACTURING COMPANY
308 Stack St., Middletown, Conn.

New York, N. Y.; Rochester, N. Y.; Detroit, Mich.; Chicago, Ill.; Minneapolis, Minn.; Pittsburgh, Pa.; Cincinnati, Ohio; Ridgewood, N. J.; Atlanta, Ga.; Memphis, Tenn.; St. Louis, Mo.; Camden, N. J.; Washington, D. C.

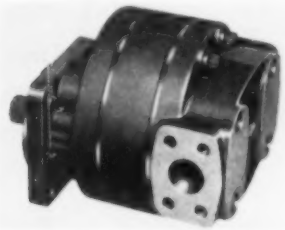
CIRCLE 15 ON TIME-SAVER CARD

NEW PRODUCTS

HYDRAULIC PUMPS
. . . absorb shock loads

Designation: HF series

Features: Compact design eliminates excessive plumbing. Built to perform under heavy shock loads on earth moving and construction equipment. Integral drive, idler shaft and gear assembly. Roller bearings for radial loads, ball bearings for thrust loads.



Specifications: Pressures to 1000 psi and capacities to 124 gpm at 2400 rpm. Capacities are changed by varying gear width.

Webster Electric Co.
Racine, Wis.

CIRCLE 306 ON TIME-SAVER CARD

PILOT CHECK VALVE
. . . stops cylinder creep

Features: Simple installation. Placed anywhere in line from control valve to cylinder. Will hold cylinder regardless of any leakage from control valve. Is automatic and requires no adjusting. Can be used on single or double-acting cylinders.

Application: Depth or angle control in agriculture implements. Holding hydraulic press ram in position. Any circuit where cylinder creeping would cause trouble.

Regent Jack Manufacturing Co.
Downey, Calif.

CIRCLE 307 ON TIME-SAVER CARD

HOSE TEST STAND
. . . is portable

Designation: Model F-2197

Features: Lightweight and inexpensive. Compact, will fit into cramped work areas. Sliding table top with plastic shield protects operator.

Specifications: Test pressures to 10,000 psi. Hose sizes 3/16 to 2 inches. Weight 90 lbs. Size 38 in. high, 42 in. long, 20 in. wide. For MIL-H-6083 or SAE 10 and 20.

Aeroquip Corp.
Jackson, Mich.

CIRCLE 308 ON TIME-SAVER CARD

MOISTURE SEPARATOR
. . . is automatic

Designation: Wilk-o-matic

Features: Automatically collects and dumps moisture gathered in compressed air lines. No drain needed, moisture is fogged to atmosphere. For intermittent-flow operation. Has 5-micron filter element.

Specifications: Made of die-cast alloy coated with corrosion-resistant material. Will actuate over 3-million times at 300 psi. Discharges at each cycle of air-operated equipment. Made in 1/4, 3/8 and 1/2 in. for flows to 45 cfm.

Wilkerson Corp.
Englewood, Col.

CIRCLE 309 ON TIME-SAVER CARD

For more NEW PRODUCT reviews turn to page 132

modern greases are not always compatible...

...that's why it's important to assure

complete flush *with* Lubriflush*

*exclusive feature of U.S. MOTORS

Today's greases have different chemical bases—lithium, sodium, calcium, barium, and other bases which your people can't be expected to keep track of. Some of these greases will not mix safely with others. Because certain chemical bases may react with each other, mixed grease may change its characteristics and become unsuitable for bearing lubrication. That is why U.S. LUBRIFLUSH—an exclusive feature of U.S. Motors—is so important. With this transverse lubrication system, old grease is *completely* flushed out as new grease is forced in. There's no mixing. New grease can be put in without bothering to determine whether it's basically compatible with the old. LUBRIFLUSH, moreover, assures proper lubrication for longest bearing life. Another good reason to specify: "U.S. ELECTRICAL MOTORS."

U.S. ELECTRICAL MOTORS INC.

P. O. BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

FREE COLOR BROCHURE
...for full information send for FREE Lubriflush Bulletin.

WHEN THE GAP NARROWS...

TRY IPC THIN SEALS

In a limited space application the *seal has to be good. Both* pressure and temperature can demand more from your seal when the opening is smaller . . . less room means the seal itself has to be made to closer tolerances . . . and it must stand up after repeated usage.

IPC "thin seals" combine the ultimate in custom compounds with the finest steels. Add IPC's bonding experience — and both compound and case are permanently joined. Result? . . . better service than can be found with other types of thin seals.

Remember . . . when the opening is closing . . . your IPC engineer will be happy to help you solve your sealing problem. Why not tell us your trouble spots, today?

IPC

OIL SEALS / O-RINGS / PACKINGS

INTERNATIONAL PACKINGS CORPORATION
Bristol, New Hampshire P5

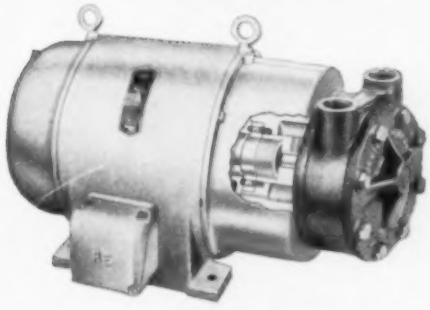
CIRCLE 73 ON TIME-SAVER CARD

...for full information send for FREE Lubriflush Bulletin.

1

2

3 NEW TUTHILL close coupled pump and motor units



3

Save space, Save weight, Cut costs

Now TUTHILL offers three pump and motor combinations developed specifically for applications where space or weight are at a premium. Furnished in a wide variety of sizes and styles, one of these combinations can provide savings in hydraulic, oil burning, lubrication or other services.

The small size of these combinations solves design problems. By reducing weight they cut shipping charges. The elimination of couplings, adapters and bases means lower costs. And even more important savings are often made through the simplification of installation procedures.

Available from Stock

A wide variety of combinations are available immediately from stock, in either large or small quantities.

For example, Number 1 above is TUTHILL's famous POWERMITE—a combination in which pump and motor are incorporated in one unit which takes up no more space than a standard electric motor (the POWERMITE shown measures only 3⅞" x 7½").

Originally restricted to large quantity applications some POWERMITE models are now available from stock for small quantity orders. The unit shown is rated for 16 GPH at 350 PSI.

For other small quantity applications TUTHILL provides a complete selection of close coupled units with the pump mounted directly on the motor. Numbers 2 and 3 above are typical.

For applications, such as hydraulics which require smaller pumps, units such as Number 2 above provide outstanding advantages. Normally they can reduce space required for pump and motor by at least 6 inches, and cut weight by several pounds. Capacities range from 20 to 300 GPH. Pumps are available for pressures up to 1500 PSI.

Larger pump and motor combinations, such as Number 3 above, can be provided with capacities up to 50 GPM, for pressures up to 400 PSI.

If you are trying to put a pump and motor into a small space, TUTHILL has the answer. Write for details.

Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities From 1 to 200 GPM; for Pressures to 1500 PSI; Speeds to 3600 RPM.

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY
981 East 95th Street, Chicago 19, Illinois

☐ Please forward complete information on TUTHILL close-coupled Pump and Motor Units for_____GPH at_____PSI.

☐ Please have your representative call.

NAME_____TITLE_____

COMPANY_____

STREET_____

CITY_____

STATE_____

CIRCLE 126 ON TIME-SAVER CARD

UNIVERSAL
SELECT "O" RING KITS

Fills Replacement Needs on 85% of All Industrial Equipment

- 180 "O" Rings in Each Kit — Sizes 1 to 25.
- Patented Plastic Case Shows You "O" Ring Sizes in Kit at a Glance!
- Interchange Data of All Leading "O" Ring Producers in Each Kit — All Manufacturers' Numbers Converted to Universal Numbers.
- Buy "O" Rings in 4 Different Materials as Shown Above. Buy Replacement Back-up Washers in these "O" Ring Sizes.
- Write for Full Information.

Several Desirable Distributorships Available

BEARINGS, Inc., 3640 Euclid Avenue, Cleveland 15, Ohio
Dear Sir:
Please send us_____ Universal "O" Ring Kits.
Material_____ Price_____
Name_____
Firm_____
Address_____
City_____ Zone_____ State_____

BEARINGS, INC.
3640 EUCLID AVENUE, CLEVELAND 15, OHIO
DIXIE BEARINGS, INC.
276 Memorial Drive, S. W. Atlanta, Georgia

CIRCLE 18 ON TIME-SAVER CARD

ROCKRITE® TUBING-

in stock
at your
local
STEEL SERVICE CENTER

You can depend on your local steel service centers throughout the country to give you fast, dependable service on ROCKRITE *cylinder-finish* seamless tubing. Whatever your requirements...a single piece or a carload...you will always find a complete range of sizes immediately available from warehouse stock.

ROCKRITE Tubing was developed for use "as supplied" for cylinder applications. To the fine surfaces and close tolerances are added higher mechanical properties and exceptional machining qualities.

Write today for ROCKRITE Bulletin R7A and the name of your nearest steel service center.

Tube Reducing Corporation also is exclusive licensee for the "Niphos" process of nickel-phosphide coating to make mild steels corrosion resistant.

ROCKRITE® TUBING

TUBE REDUCING CORPORATION

520 MAIN AVENUE, WALLINGTON, NEW JERSEY

Mailing Address: P. O. Box 959-A Passaic, N. J.

B-111

CIRCLE 125 ON TIME-SAVER CARD

USEFUL LITERATURE

For your free copy of publications reviewed, fill in the reader service card

HYDRAULIC CYLINDERS . . . for 2000 psi are detailed in Catalog 900 issued by *Hanna Engineering Works, Chicago, Ill.* It contains a cut-away view of the cylinder illustrating its features. Also included are tables giving the force obtained for all bore sizes and operating pressures.

CIRCLE 400 ON TIME-SAVER CARD

OIL FILTERS . . . designed for full-flow filtration of hydraulic oils are described in a catalog from *The Hilliard Corp., Elmira, N. Y.* In addition to complete descriptive information about the filters and various cartridges, it contains data tables to help in the selection of the proper filter.

CIRCLE 401 ON TIME-SAVER CARD

CONDENSIFILTERS . . . for filtering and dehydrating compressed air are featured in bulletin 4158 released by *Hankison Corp., Canonsburg, Pa.* It describes the unit which condenses moisture by circulating cool water, and removes particles with a cotton filter cartridge.

CIRCLE 402 ON TIME-SAVER CARD

HYDRAULIC TRANSMISSIONS . . . featuring infinitely variable speed with outputs from 2 to 200 hp are detailed in a brochure prepared by *Louis deRoll Ironworks Ltd., Klus, Switzerland.* It contains charts of speed, hp, and torque for all standard models.

CIRCLE 403 ON TIME-SAVER CARD

FILLER CAPS . . . and servicing caps for hydraulic reservoirs are included in a bulletin released by *Gabb Special Products, Inc., Windsor Locks, Conn.* Illustrations cover the company's complete line of standard and custom adapters and pressure-type filler caps.

CIRCLE 404 ON TIME-SAVER CARD

VARIABLE-DISPLACEMENT PUMPS . . . with integral adjustable pressure unloading range of 200 to 1100 psi, and adjustable volumes to 3100 cipm are featured in Bulletin 47550 from *The Oilgear Co., Milwaukee, Wis.* The bulletin is illustrated with photos and dimension drawings for both clockwise and counter-clockwise pumps of the radial piston type.

CIRCLE 405 ON TIME-SAVER CARD

TEST PLUGS . . . and filling connectors. Described in a 16-page illustrated manual by *Mechanical Products Co., Chicago, Ill.* Dimensions and engineering data on complete line of plugs for sealing vessels during hydrostatic test. Made for pressures to 1500 psi.

CIRCLE 406 ON TIME-SAVER CARD

HOSE FITTING ADAPTERS . . . for reusable Hose-lok fittings are presented in catalog 4490 issued by *Parker Fittings and Hose Div., Parker-Hannifin Corp. Cleveland, Ohio.* Included in the 12-page catalog are various types of connectors for male pipe ends and swivel nut ends.

CIRCLE 407 ON TIME-SAVER CARD

SOLENOID VALVES . . . for air, water, or oil at pressures to 5000 psi and temperatures to 450 F are shown in a folder released by *Atkomatic Valve Co., Inc., Indianapolis, Ind.* Valves are packless and made in bronze or stainless steel, either pilot or direct operated.

CIRCLE 408 ON TIME-SAVER CARD

TRANSISTOR TIME DELAY RELAYS . . . of subminiature design are described in bulletin 0558 from *Tempo Instrument Inc., Hicksville, N. Y.* It lists the models which have accurate time delays from 1.0 to 60 sec for temperatures from —55 to 125 C. Units will take 50 g's shock, and vibration to 2000 cps at 20 g's.

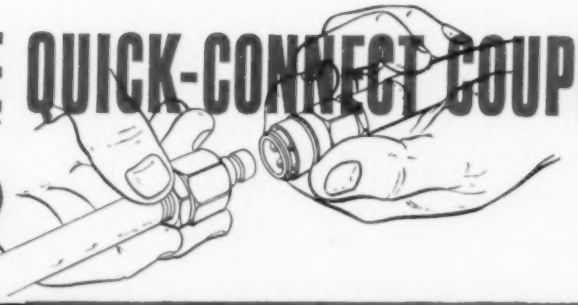
CIRCLE 409 ON TIME-SAVER CARD

CYLINDER TUBING . . . that requires no internal finishing is detailed in an engineering booklet published by *Tube Reducing Corp., Wallington, N. J.* Along with typical applications of cylinder-finish tubing it contains tables of tolerances, eccentricity, straightness, and mechanical properties to aid designers and purchasing agents.

CIRCLE 410 ON TIME-SAVER CARD

For more reviews of FREE LITERATURE turn to page 142

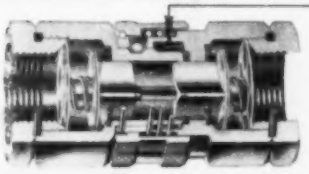
WHICH SNAP-TITE QUICK-CONNECT COUPLING IS BEST FOR YOU?



SNAP-TITE "H" COUPLING . . . . . FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge. Sizes: ⅛" thru 10". Bulletin No. 240

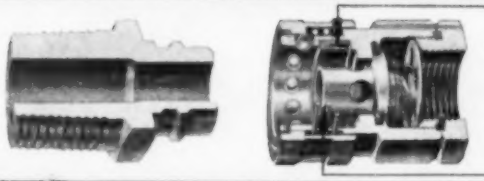


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE 'IH' COUPLING . . . . . FOR IMPACT IN AIR LINES

FOR RESISTING THE IMPACT OF RECIPROCATING AIR OPERATED TOOLS

The 'IH' Coupling delivers more air to tools. Cylinder-type 'IH' valve for 360° contact. Sizes ¼" thru ½". Bulletin No. 248.



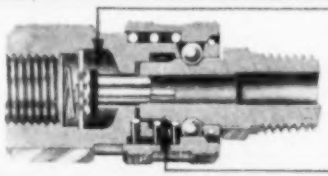
Exclusive U-Packer

360° contact

SNAP-TITE HI-FLOW COUPLING . . . FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines. Sizes: ⅛" thru ⅜" Bulletin No. 249



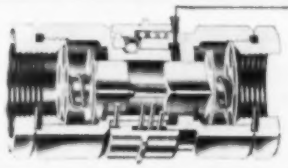
Bonded valve washer (pat. pending on valve construction)

Exclusive U-packer

SNAP-TITE "E" COUPLING . . . . . FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas. Sizes: ⅛" thru 10". Bulletin No. 250

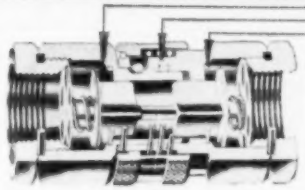


Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

SNAP-TITE 'T' COUPLING . . . . . FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS . . .

'T' is the only coupling now on the market for fluid temperatures from −40°F to +400°F. Its seals are made of Teflon for which there is no known solvent. Sizes: ¼" thru 3". Bulletin No. 270.



Teflon Valve Seal

Teflon Nipple Seal

Teflon Valve Seal

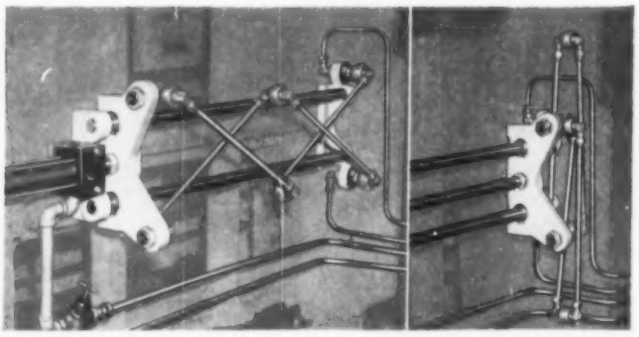
Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

SNAP-TITE, INC., UNION CITY 1, PA.

★ Snap-tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

CIRCLE 115 ON TIME-SAVER CARD



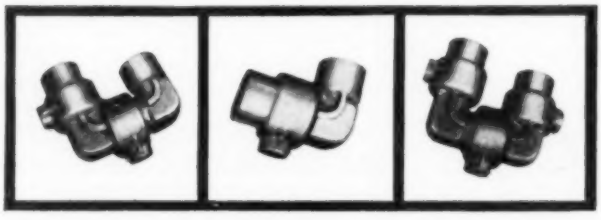
Chiksan Swivel joints, with full 360° rotation allow duplicate sets of lines (left) to be compacted into small spaces (right).

PROBLEM: EXTREME BEND RADII

SOLUTION: **CHIKSAN SWIVEL JOINTS**

Got a bend radii problem? Then let Chiksan engineers go to work on the answer. Chiksan has the years of experience and know-how to handle your problem quickly, efficiently.

Chiksan Swivel Joints provide unlimited flexibility in a compact package to meet your exacting pressure and temperature requirements. Be it for air, hydraulics, fuel, oil, water or other fluids, it will pay you to have Chiksan provide the right swivel joint for *your* bend radii problem.



Typical Chiksan Swivel Joints

CHIKSAN

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

CHIKSAN COMPANY — BREA, CALIFORNIA · CHICAGO 3, ILLINOIS · NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas · Chiksan of Canada, Ltd., Edmonton, Alta.

CIRCLE 20 ON TIME-SAVER CARD

NEW·NEW·NEW!

NEW·NEW·NEW!

second in a series

BIG HORSEPOWER LITTLE PACKAGE

VICKERS "high performance" vane pump

• high speed • high pressure • high efficiency • high service life

NEW COMPACT DESIGN . . . much more horsepower than previous pumps of the same package size.

NEW VANE CONSTRUCTION . . . positive vane tracking at all speeds assures efficient operation at increased speeds and pressures.

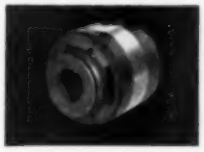
NEW SIZES not previously available . . . answers mobile equipment designers' need for greater hydraulic horsepower in limited space.

NEW PARTS INTERCHANGEABILITY . . . many common parts for single and double pumps (two pumps on the same shaft in one envelope). Lessens inventory requirements.

NEW 4-BOLT SAE FLANGE CONNECTIONS . . . will also accommodate user's 2-bolt flanges of the proper design.

NEW 2-BOLT MOUNTING (SAE 1959 STD.).

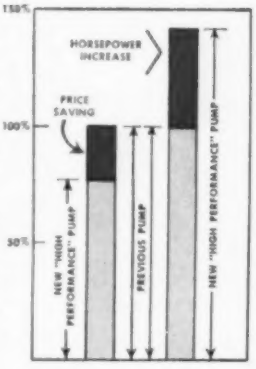
NEW REPLACEABLE PUMPING CARTRIDGE . . . all wearing parts of pump are incorporated in one replaceable cartridge. Easy field replacement without removing pump from its mount. Cartridges available in kit form.



MORE HORSEPOWER PER DOLLAR

The graph at right makes a comparison between the new Series 35 "High Performance" Pump and a previous pump of the same delivery capacity. Note the substantial increase in maximum horsepower...over 40%! This power increase is accompanied by a price saving and by a package size reduction of almost one third!

This is the second unit released in the new complete line of "High Performance" Pumps (both single and double). The first (Series 25) is available in 12, 14, and 17 gpm sizes (at SAE rating of 1200 rpm and 100 psi). The three sizes offered in the new Series 35 pump are 21, 25, and 30 gpm. Characteristics are given in table.



Model Number	Delivery-GPM 1200 RPM 100 PSI	Delivery-GPM 2000 RPM 2000 PSI	Input Horsepower @ 2000 RPM 2000 PSI	Package Size†	Weight
2V21A-**10	20.6	32.1	42.4	L. 6 15/16" W. 5 1/2" H. 6"	50 Lb.
2V25A-**10	24.5	38.0	49.8		
2V30A-**10	29.5	46.8	59.5		

†Exclusive of Shaft Extension and Mounting Lobes

8145

Write for new illustrated Bulletin No. M5108 for further details and performance characteristics.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Mobile Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

CIRCLE 137 ON TIME-SAVER CARD

★ ★ ★ ★

"One of the year's most informative movies!"

–Paul Rolnick,
Editor, "Applied Hydraulics"

"HYDRAULICS"

You are there when Pascal discovers the hydraulic principles . . . you see today's more common hydraulic problems, *your* problems, solved–right before your eyes! This 16mm color and sound movie will make your decisions easier . . . because it gives *you* valuable information. This is the movie you can't afford to miss. (Running time, 25 minutes.)

For information regarding FREE SHOWING to your plant or organization, write Hydraulic Film, Room 2006, The Texas Company, 135 E. 42nd Street, New York 17, N. Y.

TEXACO

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

CIRCLE 122 ON TIME-SAVER CARD

APPLIED **Hydraulics** & **Pneumatics**
OCTOBER 1958

Announcing

THE 1958 AWARD WINNERS

Each year The APPLIED HYDRAULICS & PNEUMATICS Prize Paper Contest, which is open to all readers, produces papers describing many phases of hydraulic and pneumatic design, application, and maintenance. This year's entries represent advanced ideas in component design, machine system application, and theoretical development. These were judged by three outstanding authorities in the fluid power field: **Morton M. Coker,** Staff Engineer, Caterpillar Tractor Co.; **George A. Keller,** Group Leader, Flight Engineering Department, Autonetics, A Division of North American Aviation; and **Clifford G. Menard,** Chief Engineer, Grinding Engineering Div., Heald Machine Co. Each entry was evaluated on the basis of practicality, economics, originality, and presentation.

On the following pages the award winners are presented together with the three top prize papers. All papers which have received an award or honorable mention will be published in future issues.

First
AWARD PRIZE
$500

H. Cutler

P. Bosen

H. Cutler, Control Engineer, and **P. Bosen,** Asst. Control Engineer, Snyder Tool & Engineering Co., Detroit. "Solving Design Problems On A Special Machine."

Smooth feed is required with the carbide tools on this machine, and a separate pump is needed for each operation. This is done with only two radial piston pumps by connecting output from each of the pistons to a manifold where flows are combined to give the required four outputs. A modification to the directional valves gives automatic unloading of the pumps through the vented relief valves.

Second
AWARD PRIZE
$300

E. T. Raymond

J. W. Hull

E. T. Raymond, Research Engineer, and **J. W. Hull,** Research Engineer, Boeing Airplane Co. "Aircraft Reliability Demands Leakproof Hydraulics."

Solutions to advanced aircraft problems foreshadow design practices in industrial machines. Brazed joints and manifolding are two of the best ways of reducing leakage points. The article presents many of the newer seal designs including 2-stage seals where a pressure drop bushing is used and the space between stages vented to the system return.

Third
AWARD PRIZE
$200

Kenneth S. Knapton, Jr.

Kenneth S. Knapton, Jr., Product Manager,—Sanders Associates, Inc., Nashua, New Hampshire. "From Missiles To Road Graders."

An exciting new application in mobile equipment hydraulics—use of a servo valve to control blade angle on a grader. Accuracy requirements in modern road building can exceed those of a missile. Electro-hydraulic servo valve is used in a system which eliminates operator skill and permits easy field maintenance.

Fourth-Seventh Prizes

$50 EACH

Maurice Beshouri, Hydraulic Engineer, J. N. Fauver Co., Detroit. "Drilled Hydraulic Manifolds." With the increased used of manifolds, this timely article discusses standard and modified units to suit almost every circuit. It gives design, and details manufacturing methods, especially for drilling long holes. The article also outlines materials and finishes, and describes a special machine built for deep hole drilling.

L. E. Farnsworth, Vice President, Engineering, Automation Machines & Equipment Co., Milwaukee. "Complex Blade Leveling by Simple Servos." Application of a simple servo system to a welding machine. To position the work as it is being welded, it is mounted on a platform which is elevated and tilted up to 30 degrees in any direction by three elevator-type, double-acting cylinders. High accuracy was not needed, and the servo valve is a standard double-end, cam valve lapped to slightly negative port openings.

Richard E. Osgood, Research Engineer, Boeing Airplane Co., Seattle. "Electro-hydraulic Servo Valve Fluid Contamination Sensitivity." Valve sensitivity to contamination causes plugged orifices and nozzles, and sticking slides. These show up as instability, reduced response, or even jamming of the hydraulic control system. The paper discusses properties of individual particles and their distribution and concentration in a system. The paper presents many ideas on servo valve design to eliminate effects of contaminated fluid.

F. D. Taylor, Engineering Manager, Short Brothers & Harland Ltd., Belfast, North Ireland. "Fatigue in High Pressure Hydraulic Components." Reviews testing methods to determine fatigue life of components. Compares good and bad design for strength. Some of the factors which are emphasized are quality control, surface finish, choice of material, and machining techniques. Good and bad design practices are illustrated.

Honorable Mention

Russell W. Henke, Russ Henke Associates, Elm Grove, Wisc. "A New Tool: High Torque/Low Speed Hydraulic Motor."

V. C. Diefenderfer, Industrial Products Div., Westinghouse Air Brake Co., "Save Cost and Time Inspecting Automatic Screw Machine Pieces."

Robert E. Pfitzenmeier, Sales Engineer, The Airoyal Co., Maplewood, N. J. "Conversion of Planer to All Hydraulic Drive With Two Complete Speed Ranges."

A. E. Schmidlin, Asst. Mgr. Development & Research and **H. A. Poole, Jr.** Project Engineer, Development & Research, Walter Kidde & Co., Bellville, N. J., "Vibration Isolation Using Pneumatic Power."

Addison T. Smith, President, The Airoyal Co., Maplewood, N. J. and **Jack Katz,** Vice President, Kingland Drum & Barrel Co. "Developing a Chemical Processing Machine."

Raymond H. Dipple, Ex-Cell-O Corp., Detroit, "Transfer Mechanisms of Automatic Transfer Machines."

N. W. Furby, Supervising Research Chemist, California Research Corp., Richmond, Calif. and **R. I. Stirton,** Manager, Product Development Dept., Oronite Chemical Co., San Francisco, "Viscosity Stability of Hydraulic Fluids."

Seymour Garrett, Greer Hydraulics, Jamaica, N. Y., "Accumulator As A Power Source."

F. M. Henderson, Senior Lecturer in Civil Engineering, University of Canterbury, Christchurch, New Zealand, "The Multiport Hydraulic Machine."

Walter A. Calahan, Design Engineer and **Francis C. Hayes,** Design Engineer, Hoke, Inc., Englewood, N. J. "A New Concept In Metering Valve Design."

Angus Eggleston, Project Engineer, Precision Engineering Div., Short Brothers & Harland, Ltd., Belfast N. Ireland, "A Servo-Controlled Rocking Table."

Harry L. Von Hoene, Cincinnati, "Air Cylinder Compression Ratios."

Charles L. Orton, Design Engineer, Pollak & Skan, Chicago, "A Rational Approach to the Velocity Problem."

Donald Firth, Principal Engineering Officer, Mechanical Engineering Research Laboratory, East Kilbride, Scotland, "Air Content and the Fluid Power Engineer."

Warren Strittmatter, Mechanical Design Test Engineer, Mechanical Engineering Dept. and **Charles Albertson,** Supervisor Sonic Section, Quality Laboratory, Grumman Aircraft Engineering Corp. Bethpage, N. Y., "Inspection of Fluids for Particle Contamination By the Use of Ultrasonics."

Joseph Aprile, Design Engineer, Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio. "Hydraulic Loading of Railroad Axle Wheel Sets."

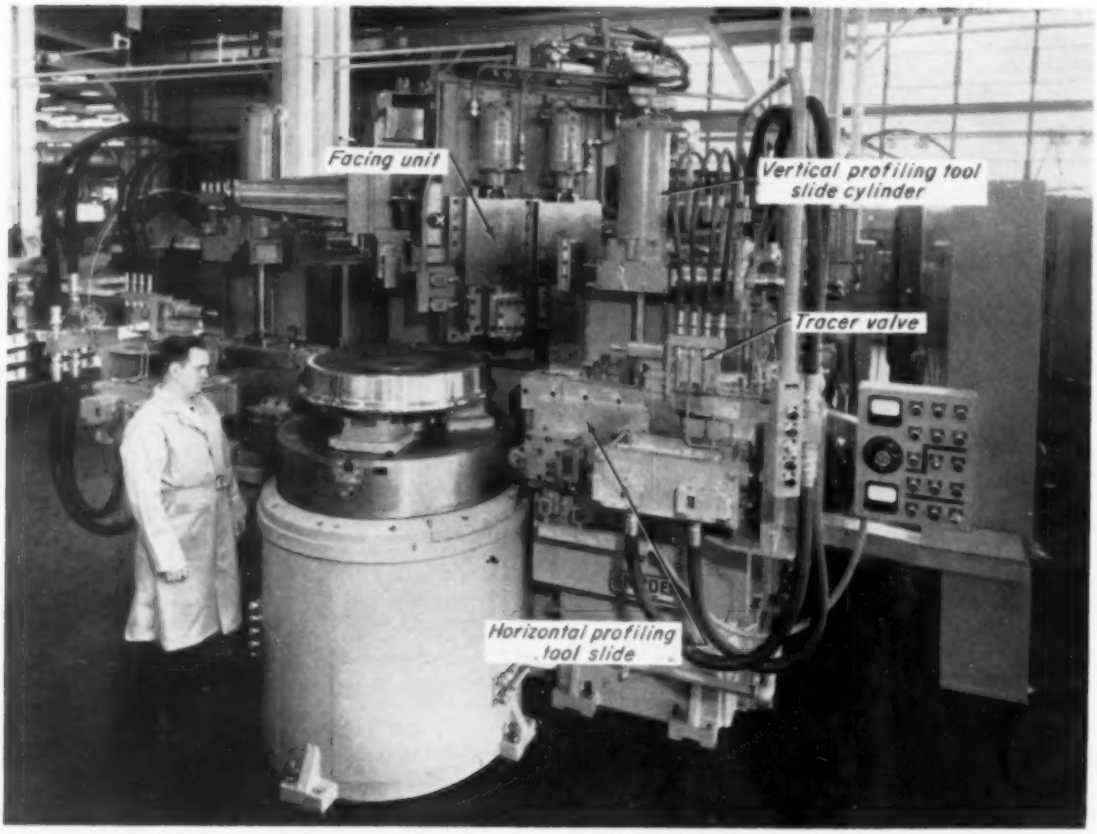
FIRST PRIZE

H. CUTLER and P. BOSEN

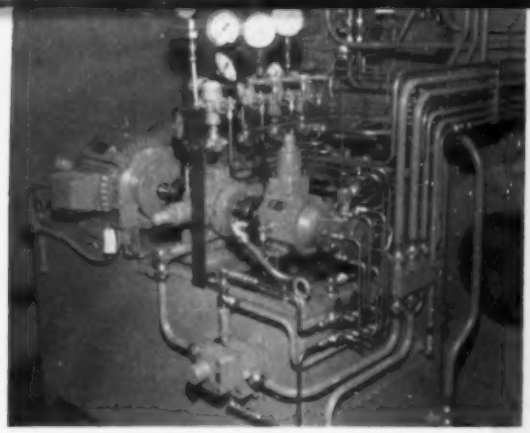
Solving design problems on a special machine

Good circuit design means economical, trouble-free operation. To achieve this goal on a special machine for finishing railroad wheels, the designers combined circuit ingenuity with careful selection of standard components.

- ***Use of multiple pumps***
- ***Unloading circuit***
- ***Feed control techniques***
- ***Servo valve control***



SIXTY POUNDS of metal are removed in 148 seconds when a railroad wheel is finish machined from a rough casting. Hydraulics feeds the cutting tools.



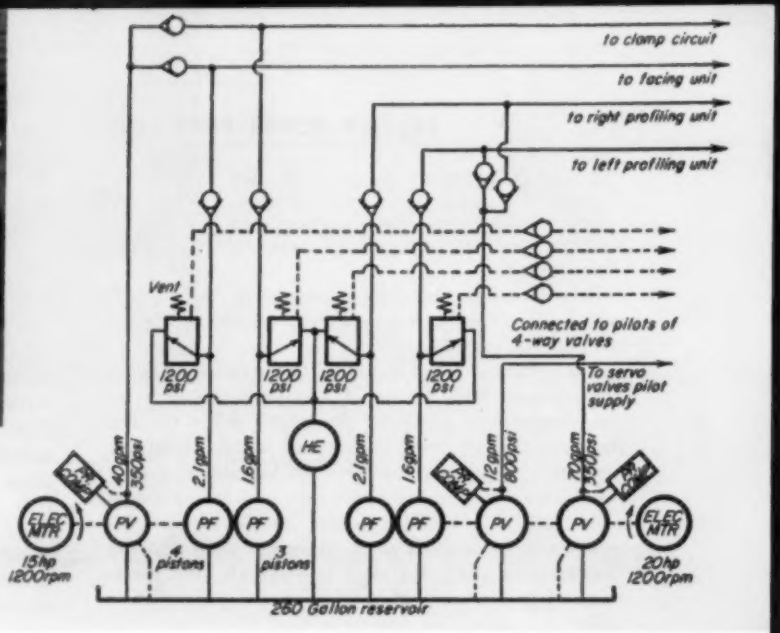


FIG. 1. POWER UNIT uses two large variable delivery pumps. One for clamping and facing; the other for traversing the profiling tools. Output from each of the 14 pistons on two radial piston pumps is piped to a manifold where flow is combined to give four separate outputs. Each of these four outputs powers the feed of a tool slide.

PRELIMINARY study of the work to be done by hydraulics on a heavy-duty special machine led to these conclusions:

1. Use a separate pump supply for each of the four machine elements: clamping, facing, right profiling, and left profiling.
2. Provide enough gpm so that maximum traverse time for all slides is eight seconds.
3. Size cylinders so that at least 25 cipm is available for metering.
4. Design power unit for a 3 x 6 foot space.

Why use four pumps when many milling machines having one pump to supply several units operate without trouble? Use of carbide tool bits taking heavy cuts is the answer. Their life is quickly shortened by pressure surges. We felt that one pump might momentarily starve one feed unit while another was starting up. During this hesitation, the compensator of the flow control in the meter-out circuit would lose a little oil, and then a slight surge would follow. Although careful design can minimize this situation, our application demands such severe duty on the tools, we want the smoothest possible feed on each tool slide.

Gpm requirements were based on an estimate of cycle time. We weighed the advantage of increasing the cycle by two seconds, which would allow a reduction of 25% in the gpm for traverse, against production at the desired eight second traverse time. We decided that the large reduction in cost of the hydraulic power unit would not offset the loss in available production.

Sizing cylinders to give at least 25 cipm flow was done to ensure steady feed rate even with some oil lost through internal leakage.

• **Power unit selection**—To satisfy the traverse time requirements, 30 gpm was needed on each of the profiling units and 35 gpm was needed on the facing slide. Clamp cylinders in the rotating chuck needed 40 gpm. Nothing traversed during clamping or unclamping.

The final pumping circuit, Figure 1, shows each of the three work units with a separate small volume pump for feed. There is also a separate small volume pump for holding pressure on the clamps. Each of the two large volume pumps provides the traverse volume for two units. The traverse pumps are variable volume, pressure compensated, vane type, and rated for a maximum of 1000 psi. The small volume pumps used for feed are piston type, fixed displacement, rated for a maximum of 2000 psi and used with relief valves.

While the circuit shows four separate high pressure feed pumps, there are really only two. Here's how it's done. Each piston pump has seven pistons, each a pump in itself. Instead of allowing the flow of the seven pistons to combine, the output of each piston is piped to a manifold. The manifold combines the flows in two groups, one being the output of three of the pistons and the remaining one the output of the other four pistons. Each of the groups is provided with a relief valve.

To get rid of the heat generated by the small volume high pressure pumps, all the tank lines from the relief valves are run together through a small air cooled heat exchanger.

The pilot portions of the solenoid controlled, pilot operated, four-way valves is used to provide dumping of the high pressure. The end cap of the main spool was drilled and tapped. A line runs from that hole to the vent connection of the relief valve. When the pilot spool is in its center position, or in the position that will return the slide, the relief valve will be vented through the pilot drain of the four-way valve. This will drop the pressure of the fixed volume pump close to zero. When the pilot valve is shifted to send the slide forward, the line to the vent connection of the relief will be under pressure. Then the check valve in that line will close, blocking the vent, and the pressure will rise to the relief valve setting. When the pumps are unloading, the check valves connected to the output of

the high pressure pumps will be sealed by the traverse pump pressure.

This automatic dumping arrangement has worked very well and made it unnecessary to use additional components.

The pumping circuit is similar to the common HI-LO arrangement. With the use of a variable volume pressure compensated pump for the large volume, there is the advantage of being able to use a portion of the maximum output and not have the balance go over a relief, generating heat. Because the pump output varies with the demands of the system, the horsepower required will be at a minimum. Having a separate fixed displacement pump for each feed circuit, any variations of pressure, or traversing of one unit, cannot affect any other unit that is in feed.

There is also a small vane type variable volume, pressure compensated, pump to supply oil for the pilot circuits of the tracer valves.

The two large volume pumps have a shaft at each end, and the pump used for the tracer valve pilot supply is double ended. One motor drives a large volume pump, which is coupled to the pilot supply pump, which in turn drives a piston pump. The other motor drives the second large volume traverse pump, which is coupled to the remaining piston pump. The tank on which the two motors and five pumps are mounted takes a floor plan space of 25 by 68 inches. The reservoir capacity is 260 gallons.

• **Profiling**—The profiling unit, Figure 2, consists of a platen mounted on vertical ways and actuated by a hydraulic cylinder. The platen carries a horizontal slide also actuated by a hydraulic cylinder. Mounted on the horizontal slide is the tool block and the servo valve. The cylinder is mounted so that the barrel moves and the rod is fixed, so there's solid pipe between the cylinder and the servo valve. The stationary template, is profile duplicated on the car wheel flange.

For an accurate profile and smooth surface the surface feed rate must be fairly constant. As the horizontal slide is always positioned by the template through the servo valve, its rate of movement is determined by the feed rate of the vertical slide. To obtain a constant feed rate tangential to the surface being machined, the vertical feed rate has to vary with the slope of the contour being generated. To give variable feed to the vertical slide, the knob of the standard flow control valve was replaced by a pinion. The pinion is operated by a spring loaded rack. The end of the rack has a roller that rides on a cam which is mounted on the vertical platen and moved with it. The cam was developed graphically. The flow control is used in a conventional meter out circuit.

• **Servo Valve**—A standard industrial duty two-stage electro-servo valve is used. The electric torque motor was replaced with a mechanical follower to operate the control spool of the servo valve. The valve can handle a maximum of 10 gpm, is rated at 2000 psi.

Before the horizontal slide contacts the template, the spring in the follower assembly positions the control spool so that the servo valve will port oil to the cylinder to send the slide forward toward the template. The servo valve is attached to and moves with the horizontal slide. When the servo valve follower contacts the template, the control spool is very slightly depressed, stopping the movement of the horizontal slide. The vertical slide then starts to feed up. As it moves up, the follower riding on the template will not allow the horizontal slide to deviate from the contour of the template, for if it is too far forward, the template will depress the follower sending the horizontal slide back. If it is too far back, the follower would be released and the horizontal slide would be moved forward. The servo valve is so accurate it controls movements of less than 0.001 inch.

• **Traverse circuit**—The servo valve can handle only a maximum of 10 gpm. To make the required cycle time, traversing the horizontal slide in and out needs about 30 gpm. Circuit shown in Figure 3 solves this volume problem.

Connected to the cylinder in parallel with the tracer valve is a 1-¼-in. standard solenoid controlled pilot operated valve. To prevent the leakage of that four-way from affecting feeds, pilot operated check valves are between the cylinder and the four-way. The pilot lines are crossed to the opposite cylinder line. When the four-way valve is operated, pressure on one line will open both check valves; one through direct pressure and the other through its pilot connection. In addition, so that there is no oil loss through the tracer valve when it is traversing, the tank and pressure lines of the tracer valve are run through a blocked-center ¾ inch four-way valve. Only one solenoid of that spring centered valve is used. Thus when tracing, this solenoid is energized so oil can flow in and out of the tracer valve. As this four-way is not between the servo valve and the cylinder, its leakage will not affect the accuracy of the tracing. When traversing, the solenoid is deenergized. The flow of oil from the tracer valve is then blocked.

• **Facing the wheel**—The facing unit is a horizontal slide moved by a 30 inch stroke cylinder. The platen of that slide carries two cross-slides that bring the tool blocks down in position.

Sequence of operations:

1. Rapid traverse forward until cam operated valve decelerates slide.
2. Stop slide by the tripping of a limit switch.
3. Lower tool blocks so tools are to depth of cut.
4. Fast feed forward while facing rim and hub.
5. Slow feed forward while form tool shapes radius between rim and flange.
6. Dwell.
7. Raise tool blocks.
8. Rapid return slide.

Because of the thrust requirements, a 6 inch bore cylinder was selected. To reduce oil requirements, a

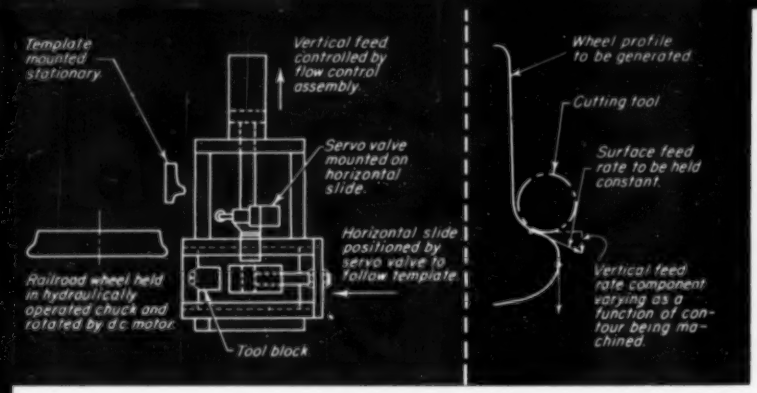

Template mounted stationary
Vertical feed controlled by flow control assembly
Servo valve mounted on horizontal slide
Horizontal slide positioned by servo valve to follow template
Railroad wheel held in hydraulically operated chuck and rotated by d.c. motor
Tool block
Wheel profile to be generated
Cutting tool
Surface feed rate to be held constant
Vertical feed rate component varying as a function of contour being machined

FIG. 2. WHEEL PROFILE is cut by action of servo valve against a template. This controls motion of horizontal slide.

differential circuit, Figure 4, powers the traverse with a two to one piston rod. When traversing forward, the pump supplies 35 gpm. To obtain the differential action, the rod end of the cylinder is connected to the head end by means of a pilot-operated check valve and a plain check valve placed back to back. In addition, a plain check valve is placed so oil cannot go through the four-way valve when the cylinder is traversing forward. Then to rapid traverse forward, the forward solenoid of the 1-¼-in. four-way valve and the ⅛ inch pilot valve are energized to bring pressure to the cylinder and open the pilot check valve. The pump supply of 35 gpm will be added to the 35 gpm supplied from the rod end to send the cylinder forward with 70 gpm. With this circuit, a smaller four-way valve can be used than if the full 70 gpm had to pass through it for differential traverse forward. A small amount of oil will bleed off through the flow control without materially affecting the traverse rate. De-energizing the spring offset ⅛ inch pilot valve will stop the traverse and put the slide into feed. ▼▼▼

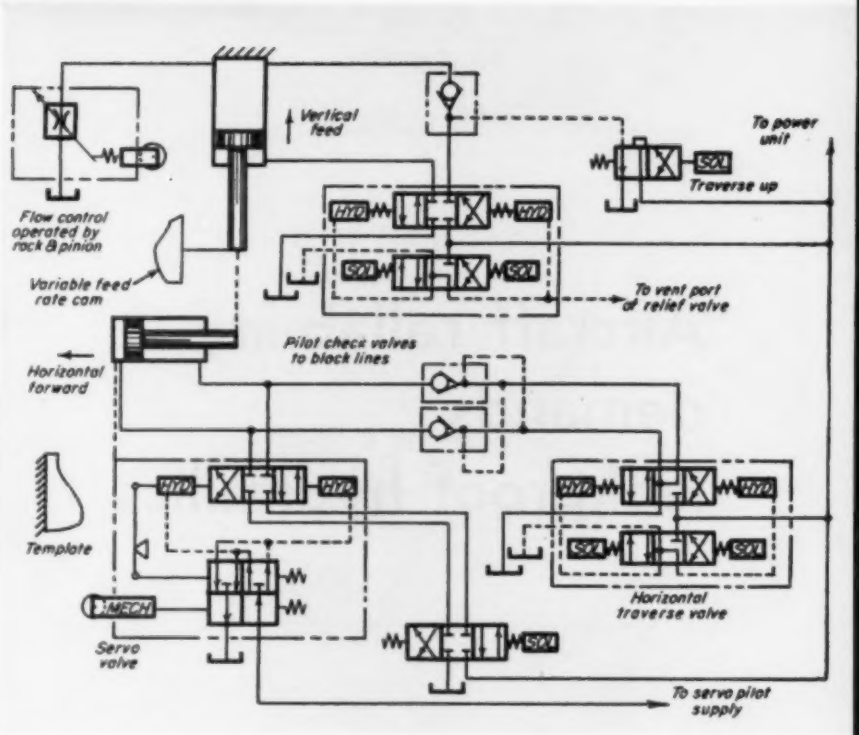


FIG. 3. DURING RAPID traverse the servo valve is out of action. While profiling, check valves block any leakage from the traverse valve from affecting servo operation.

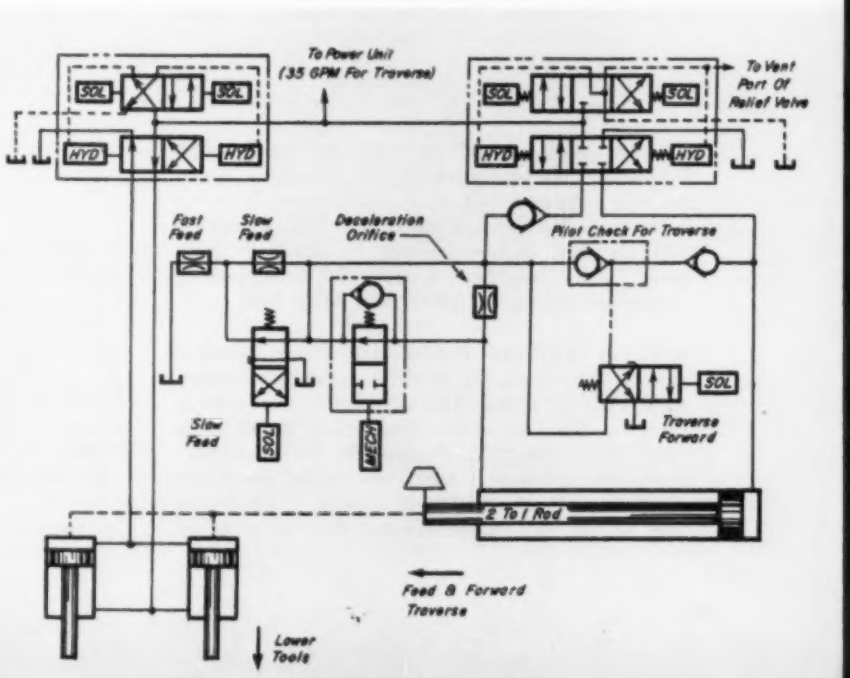


FIG. 4. DIFFERENTIAL CIRCUIT to speed traverse motion of facing tool is arranged so that 4-way valve carries only pump volume. Additional 35 gpm from cylinder rod end flows through the pilot check valve.

SECOND PRIZE

E. T. RAYMOND
and J. W. HULL

Aircraft reliability demands leakproof hydraulics

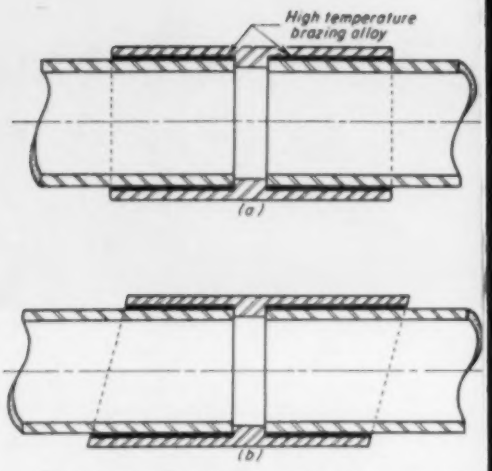


FIG. 1. BRAZED TUBE JOINTS permanently connect tubing runs which do not have to be broken for maintenance and overhaul. Design in (b) reduces extreme fiber stress in tubing.

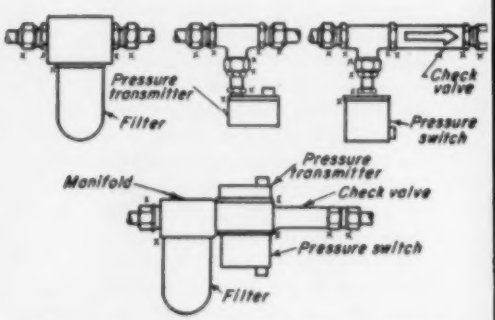


FIG. 2. MANIFOLDING COMPONENTS eliminates 17 to 23 possible leakage points in a conventional installation.

IN DESIGNING aircraft hydraulic systems for high reliability, the prevention of fluid leakage is one of the most important factors. In many cases all system fluid can be lost through one critical leak. Therefore, not only must each component be inherently leakproof, but its connections must be 100% foolproof on installation both in the factory and in the field.

• **Fewer Leakage Points**—Minimizing potential leakage points is one of the principal steps in designing a leakproof system. This can be done in two ways. First, by using permanent connections at all joints which do not have to be disconnected for maintenance and overhaul. Figure 1 shows two brazed sleeve type connections. Cutting the sleeve ends on a bias, rather than square, reduces the extreme fiber stress in the tubing by distributing the change of cross section over a greater length.

The second way to eliminate leakage points is by manifolding components. Figure 2 shows a typical component package in which twenty-three possible leakage points were reduced to six by manifolding. In addition to increased reliability, both of these leakage control methods will reduce weight and size. These advantages will outweigh the loss of component interchangeability and additional cost, if any. Both principles were used in designing the actuator shown in Figure 3. It has a single seal at the junction of the cylinder barrel and one head, brazed-in tube fittings, and internally press-fitted metal rod seals.

• **Improved Seals**—All static and dynamic seals in

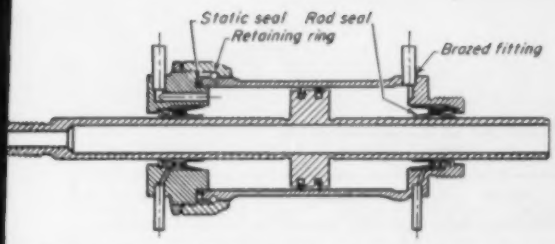


FIG. 3. ACTUATOR HAS SINGLE STATIC SEAL at junction of cylinder barrel and cylinder head. Tube fittings are brazed-in, and piston rod seals are internally press fitted.

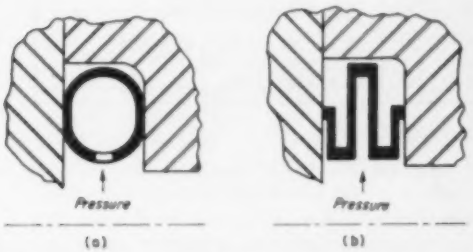


FIG. 4. TWO METAL STATIC SEALS, being evaluated for future systems, are the metal O-ring (a) and the bellows type (b). Both are pressure energized.

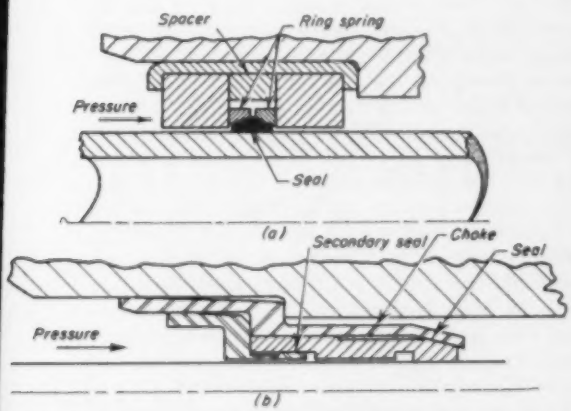


FIG. 5. TWO METAL PISTON ROD SEALS under development are the ring-spring type (a) and the choke seal (b).

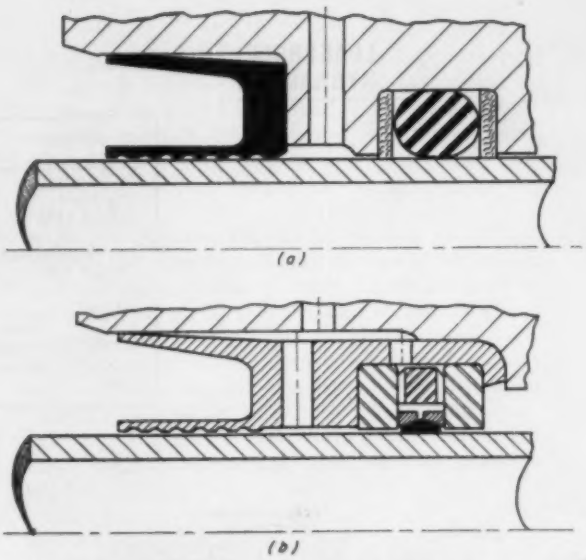


FIG. 6. TWO-STAGE PISTON ROD SEALS have a pressure-drop bushing for first stage. Space between stages is vented to system return. In (a) a conventional O-ring is used for the second stage: in (b) a ring-spring seal is used.

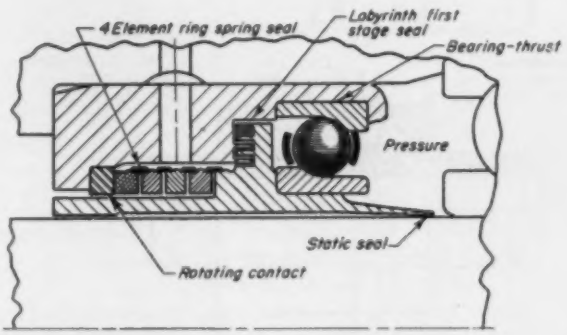


FIG. 7. TWO-STAGE PUMP SEAL has a first stage labyrinth seal and a second-stage series of ring-spring seals.

each component must be carefully analyzed, designed specifically to suit the application, and thoroughly tested under the conditions of operation. The principal seal types are:

1. Diametral and face type seals in components
2. Seals in universal boss fittings
3. Linear actuator rod seals
4. Rotating seals in swivel joints and rotary actuators
5. High speed rotating seals in pumps and hydraulic motors.

Elastomeric O-rings are still considered best for most seal applications. However, they do have many limitations. Some of the problems encountered in current systems are:

1. Extrusion nibbling in breathing seal glands
2. Spiral failures due to inadequate lubrication of the actuator rod
3. Susceptibility to surface damage which cannot be controlled, even by 100% part inspection
4. Incompatibility with new synthetic fluids
5. Storage limitations

• **Metal Seals**—Because of the above problems, and the temperature limitations of elastomers, designers are looking more toward the use of metal seals for future aircraft and missile applications. Two metal static seals currently in use on advanced airborne systems are shown in Figure 4. The metal O-ring face seal (a) is simple and effective but requires high installation forces. The bellows face seal (b) seals effectively with low installation forces and appears accept-

TABLE I
Comparison of Tubing Materials for 3000-psi System

MATERIAL		160°F SIZE-IN	160°F LB/FT	400°F SIZE-IN	400°F LB/FT	800°F SIZE-IN	800°F LB/FT
304 Stainless ⅛ Hard MIL-T-6845		½ x .035	.226	½ x .042	.257	½ x .049	.282
6061-T6 Aluminum MIL-T-7081		½ x .083	.160	½ x .120	.195		
AM 350	New Austenitic Alloys	½ x .020	.164	½ x .020	.164	½ x .020	.164
17-7PH	New Austenitic Alloys	½ x .016	.147	½ x .020	.164	½ x .028	.198
A-286	New Austenitic Alloys	½ x .028	.198	½ x .028	.198	½ x .035	.226

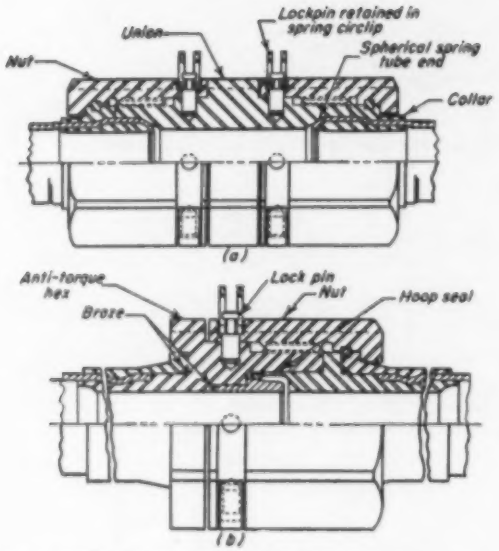


FIG. 8. TWO TUBE FITTING DESIGNS under development for heat treated AM 350 tubing in high temperature systems.

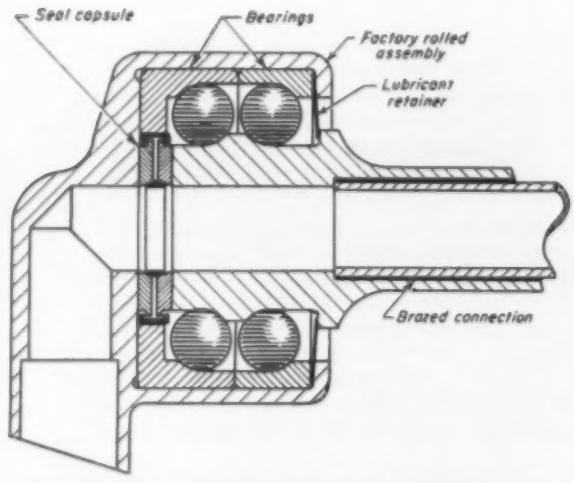


FIG. 9. SWIVEL JOINT WITH RING-SPRING METAL SEAL unit is factory assembled with brazed tubing connection.

able for many applications. However, neither is reliably reusable, nor will tolerate component deflections causing significant separation of the sealing faces. The ring-spring static seal shown in Figure 5, under development at Boeing, repeatedly has sealed satisfactorily with high component deflection, and is reliably reusable. It requires installation forces comparable to the metal O-ring.

The most difficult seal problems occur in the dynamic sealing of linear actuator rods and high speed rotating shafts. Considerable rod seal work has been done at Boeing on the ring-spring and choke seals shown in Figure 5. The ring-spring seal (a) tolerates angular misalignment between the rod and seal gland, and has averaged 60,000 full stroke cycles at 450 to 550 F in a 4000-psi system using a fluid of poor lubricating qualities. Friction has been higher than desired for stable flight control servo performance. The choke seal (b), designed specifically for low friction, has consistently operated at low friction levels in laboratory tests. A significant advantage in favor of these metal seals is that failures have occurred gradually rather than blowing out suddenly as sometimes happens with elastomeric O-rings. This reduces the possiblity of draining a system during flight.

• **Two-Stage Seals**—To improve reliability further, many metal seal configurations, and O-rings as well, can be used in series with a pressure drop bushing making a two-stage seal. The cavity between stages is vented to the system return through a check valve, thus subjecting the external seal to return line pressure only. The pressure drop bushing serves as a flow limiter if the second stage seal fails. A typical pressure drop bushing, Figure 6, has a thin pressure-actuated lip which follows the deflections of a thin walled hollow rod.

The two-stage principle is also effective in the design of high speed rotating seals. Figure 7 shows a pump (or motor) shaft seal assembly incorporating a labyrinth seal in the first stage and a series of ring-spring seals in the second. The cavity between is vented to reservoir through a check valve, so the labyrinth acts as a surge damper protecting the second stage seal. If the second stage seal fails, the labyrinth

may limit the external leakage flow sufficiently to prevent draining the reservoir during flight.

• **New Tubing and Fittings**—Higher system temperatures will require new tubing materials to replace the 18-8 stainless steel and aluminum alloys now used. Several new austenitic stainless steel alloys have been evaluated recently for temperatures to 800 F. Table I compares wall thickness and weight of tubing in three of these alloys with cold drawn (⅛ hard) AISI 304 stainless, and 6061-T6 aluminum tubing. This comparison is made for ½-inch tubing in a 3000-psi system. The potential weght saving is obvious, but many production and quality problems must be solved to insure reliability.

Absolute quality control is essential to insure relibility of all tubing assembles. Each piece of tubing must be inspected before and after installation, starting with X-ray examination when received from the mill and continuing with boroscope checks to detect surface defects. Extreme care must be taken to avoid physical damage such as denting, scratching, or flattening of the tube during forming or installation.

Along with the trend toward higher temperatures and the requirement for new materials is the need for improved, reconnectable fittings. AN and MS fittings probably will not be reliable enough for many future systems because:

1. Tubing fatigue life is limited because of poor support by the AN sleeve.
2. New tubing materials may be notch sensitive to the sleeve bite of MS fittings at some elevated temperatures.
3. Threads are not sufficiently accurate to insure maintenance of original installation torque.
4. There is no positive method of preventing nut back-off under high vibration loads.

To overcome these factors, Titeflex, Inc. under Boeing sponsorship, developed the fittings shown in Fig. 8. These configurations provide positive support of the tubing, pressure energized sealing, positive locking devices, and no tube notches. They have not been evaluated conclusively, but appear to be promising solutions to the fitting problem. More extensive testing under conditions of vibration and pressure impulse will be required before they can be recommended.

Improvements are also needed in individual tubing run installations. In advanced aircraft systems each tubing run be individually engineered to insure support against flight vibration frequencies causing resonance, and against adverse stresses induced by thermal expansion or structural deflection. Some methods to accomplish this include coiled tubing or expansion bands, expansion joints, and scissor links with swivel joint pivots.

• **Swivel Joints**—The use of moving swivel connections may seem to contradict the idea of minimizing potential leakage points. However, the advantage of relieving the tubing stresses at points of high structural or component deflection must be carefully considered. Furthermore, swivel connections which are relatively foolproof help improve reliability. Figure 9 shows a factory rolled swivel joint with brazed tubing connections. Although a metal ring-spring seal and a metal lubricant retainer are shown, the unit could also be made with elastomeric seals.

• **Designing for Maintenance**—In addition to all other design factors, maintenance provisions must be given utmost attention to prevent human error which is one of the biggest causes of unreliability. As we all know from "Murphy's Law" if maintenance can possibly be done wrong, some day it will be!

In high density aircraft of the future, cramming hydraulic equipment into extremely small space makes designing for easy maintenance extremely difficult. Because hydraulic systems will be specially designed for each aircraft, designs cannot be standardized. However, the following should be general objectives:

1. Design for easy access, especially components requiring servicing.
2. Design components for rough handling.
3. Design for use of standard tools.
4. Use a positive locking device for all tube fittings to give a quick visual check of the joint.
5. Package fragile component parts in rugged capsules to make overhaul and repair more foolproof.
6. Design to make incorrect assembly and installation of components impossible.
7. Provide quick positive identification of all components.

Only by disciplined use of these design precepts can the complex systems of the future be maintained in service with any hope of meeting the reliability levels now required. ▼▼▼

Leakage control is one of the basic problems in industrial hydraulic systems as well as aircraft systems. Here are some of the articles recently published in APPLIED HYDRAULICS & PNEUMATICS *giving design ideas to eliminate leakage.*

Manifolded Boosters Improve Reliability. June '58
How O-rings Seal Air and Oil Components. May '57
Use of Manifolds Reduces Potential Leakage Points. May '57
Port Seals . . . What's Available, What They Can Do. May '57
How To Install a Packing on Air and Oil-Powered Equipment. May '57
Static Sealing with Metal O-rings. May '57
Selection of Flareless Fittings for Aircraft Circuits. May '57
Prevent O-ring Failure by Proper Compound Selection. Oct. '57
How to Design for O-rings on Air and Oil-Powered Equipment. June '57
Swivel Joints . . . What They Are, How They're Used. Sept. '56

KENNETH S. KNAPTON, JR.

From missiles to road graders

Drawing on its background and experience in missile inertial guidance, Sanders Associates, Inc., is developing and field testing an automatic blade level control system for a Galion road grader. This automatic system uses electro-hydraulic controls to keep the desired angle or slope of the blade, so that it is unaffected by the grader's frame. This is the first application of electro-hydraulic servo valves on earthmoving machinery, and it is a significant step forward in sophisticated control systems on a commercial product.

A ROAD GRADER moves earth for precise leveling and grading. In manually operated machines, the operator controls each side of the blade, or mold board, with manual valves that direct hydraulic fluid to actuators adjusting the height of each side of the blade. The operator is expected to maintain the desired angle or level of the finished grade by continually adjusting blade angle as the grader moves over uneven ground. This problem is complicated by the requirement to keep the blade height equal to the *blue tops*. These are surveyor's stakes set into the road bed to show the finish grade level. A grader operator must be thoroughly experienced and must have excellent reflexes and depth perception to control the finish grade to the required accuracy.

With the improvements in new high-speed, super highways, accuracy requirements of finished grades have been increased to provide a finished road bed without the ripple or bumps which are noticeable when traveling at high speeds. In many states, this accuracy is ¼ in. in ten feet or, in terms of a road grader, ⅛ in. error between the ends of the grade blade. Expressed as angular accuracy, this is approximately .001 radian which is considerably greater accuracy than some missile requirements.

• **Automatic Control**—Galion engineers wanted a control system that would automatically sense true vertical and control the blade to maintain a preset level or grade, even over rough terrain. This would simplify the operator's job and give a more accurate finish grade.

This is the function of the automatic blade angle control system. Based on principles of missile inertial guidance, the system has a vertical sensing device and an electrohydraulic servo valve. A vertical sensing device measures the angle between the road grader frame and true vertical, and converts it to an electrical signal. A feedback sensor measures the angle between the road grader blade and the frame, and also converts it to an electrical signal. These two signals are added to give a signal corresponding to the angle between the blade and true vertical. This signal is compared to the input set on the slope setting dial according to the required blade angle. The electrical difference (error) is fed into a transistorized amplifier whose output operates an electro-hydraulic servo valve.

The servo valve ports oil to the hydraulic actuator moving the blade to eliminate the error. Automatic control is applied to one end of the blade only. The other end is controlled by the operator with a manually operated valve. He sets the blade height or depth of cut according to the blue tops.

• **Hydraulic System**—In the hydraulic circuit shown in Figure 4, the switching valve can be set for operation in any of the three positions, (1) full manual, (2) automatic control on left side of blade, and (3) automatic control on right side of blade.

Full manual operation allows the grader operator to control each side of the blade manually by moving each control valve separately. Flow of the electro-

FIG. 1. ACCURACY of this rugged road grader sometimes has to be greater than required of a missile.

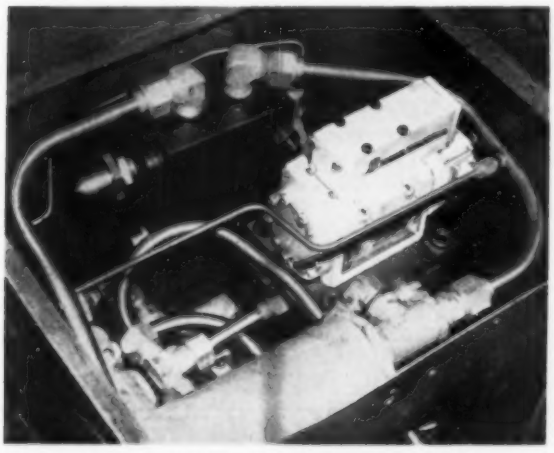


FIG. 2. SERVO VALVE IS MANIFOLD-MOUNTED close to other hydraulic components under driver's seat. Location was chosen for convenience and ease of maintenance or replacement of filter elements.

hydraulic servo valve is shut off from the actuator, and flow from the *B* section of the tandem pump is bypassed to tank. The other section of the pump supplies the manual valve bank which has several other manual control valves.

When the switching valve is set in either the LEFT or RIGHT automatic position, the corresponding left or right side of the blade is automatically controlled. The other end is manually controlled by the operator. Hydraulic operation is the same in either position.

Pump pressure is limited to 1500 psi by a relief valve. A pressure reducing valve, set at 1000 psi, and an

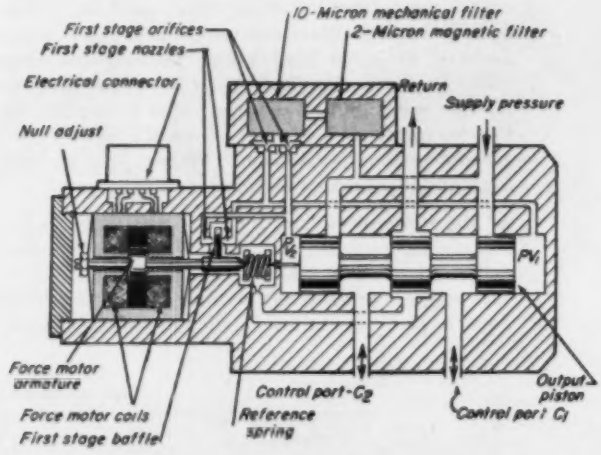


FIG. 3. FORCE MOTOR of servo valve converts low power input current into armature force. Armature displaces baffle between two fixed nozzles supplied with constant pressure. Baffle displacement varies nozzle pressures PV_1 and PV_2 which are applied to each end of output piston. Difference in pressure causes force unbalance on output piston which is displaced, porting oil to load.

Position of output is fed back through reference spring as force on motor armature. When feedback force equals input armature force, first stage is nulled. Baffle is again centered between nozzles, pressures PV_1 and PV_2 are equalized, and unbalanced force on output piston is zero. Piston is held stationary porting required flow to load through ports C_1 and C_2.

accumulator maintain pressure and flow to the electro-hydraulic servo valve. This valve, which is essentially a 4-way, meters the flow of oil to the actuator in proportion to its input current.

The electro-hydraulic servo valve which is the heart of the automatic control system, is a production unit similar to the aircraft valve, except that it permits higher flow and is more rugged. It is a 2-stage, amplifier which converts a low electrical input signal into a hydraulic flow output. In this application, it has an input of 0-110 ma and an output of 0-16 gpm at 1000-psi pressure drop across the valve. The valve has in-line design with internal force-feedback between the dual, nozzle-baffle first stage and the spool type output stage. Oil flow to the first stage is thoroughly filtered through an integral, replaceable 2-micron magnetic filter and a 10-micron mechanical filter. Although originally designed for 3000-psi supply pressure, this application operates at only 1000 psi.

• **Filtering**—A servo valve is precisely made with very close tolerances. It requires good filtration for the extremely long life and reliability required in this application. Main pump flow is filtered through a 40-micron paper filter to remove larger particles. It then flows through a 10-micron, mechanical filter and a 2-micron magnetic filter before reaching the servo valve. The servo valve itself has a 10-micron mechanical filter and a 2-micron magnetic filter in its pilot line. For full protection, the lines from the valve to the actuator each have a 10-micron filter to keep particles worn off the actuator from reaching the servo valve.

• **Maintenance**—Since the components of this system may require field servicing, the system has been designed for easy maintenance and servicing.

A test-jack panel on the main control panel permits a quick check of electrical inputs and outputs to locate trouble in the vertical sensing device, feedback sensing device, amplifier, or servo valve.

Each of these components is a separate unit, and is easily replaced. Removal requires only loosening an electrical plug or mechanical shaft coupling, or removing bolts.

• **Calibration**—To calibrate the automatic control system, the grader is maneuvered until the grader frame above the vertical sensing element is level. The slope setting dial is then rotated until the blade is level, and the indicator line is set to zero. ▼▼▼

PROGRESS REPORT ON THE GRADER

Although we're not quite ready to write orders for servo controlled graders just yet, we have several prototype models under construction. One completed machine is undergoing field tests. We're hoping to have a limited quantity available for sale in the spring of next year.

Tests have shown excellent performance from the grader, with an increase in production over manually operated machines. Furthermore, the servo system gives all the accuracy we expected.

The big development problem which remains is filtering. It's got to be good for satisfactory performance of the servo valve, and users will have to perform periodic maintenance to keep the filters clean. We're shooting for a weekly filter change.

We're investigating both porous metal and paper element filters. Paper units have the disadvantage of passing dirty oil to the system when they're full, but we may be able to solve this with a tank connection from the filter to drain off this dirty oil. We've found that porous metal filters are more expensive and hard to clean. The aircraft type filters that we've worked with do not have the capacity that we need for this application.

Users must understand that they'll have to give this machine better maintenance than they're used to giving most construction machines, but they'll find it pays off with faster, easier operation wtih only a 20% greater initial investment. The plug-in design of the servo system components simplifies replacement.

We think this is the beginning of a trend in applying the so-called sophisticated, type controls to earth moving machines. This servo system controls only one of eight operations on the grader, and there are others that could be controlled by a similar system.

JAMES ROBERTS, Project Engineer
Galion Iron Works & Mfg. Co., Galion, Ohio

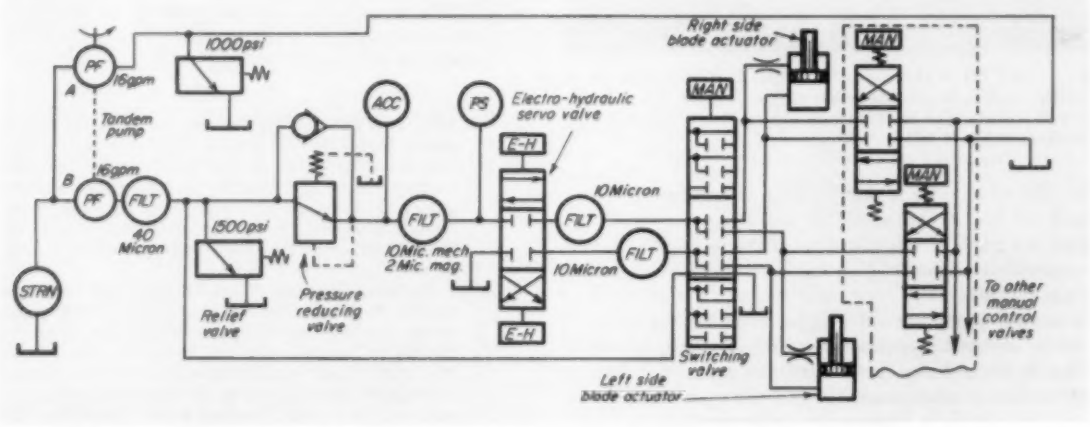
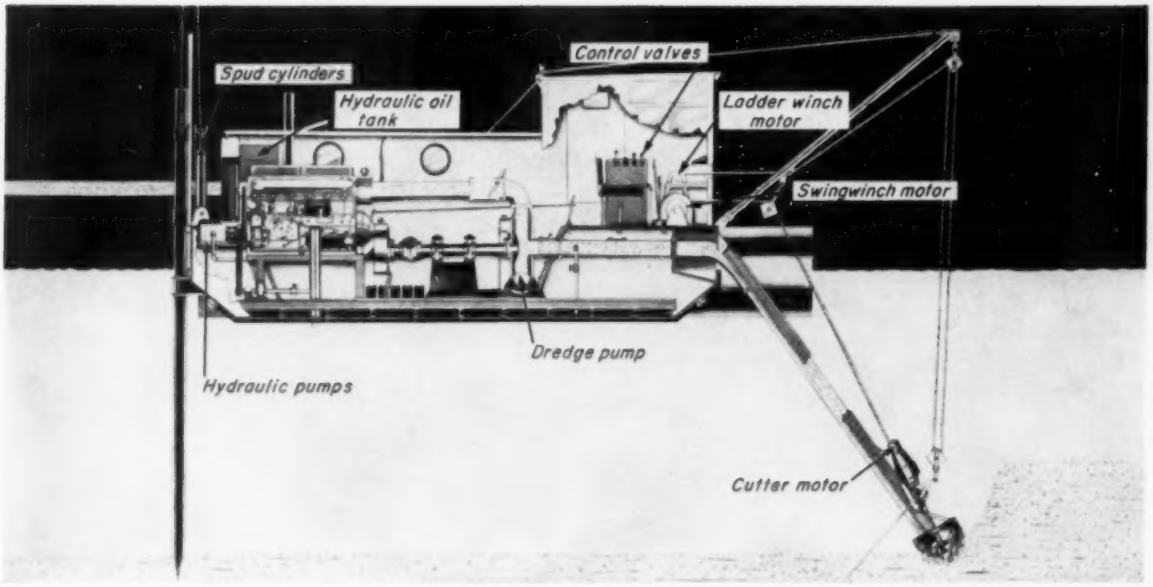


FIG. 4. AUTOMATIC CONTROL and manual control are in parallel. Manual operation is controlled by 4-way valves. Eight-way switching valve selects either side for automatic control; unloads pump in neutral position.



Triple tandem pumps power up dredge

COMMERCIAL's 3-in-1 pumps save on space, extra equipment, installation and maintenance costs in new Dixie-Dredge

Working independently or in combination, three COMMERCIAL heavy-duty fluid-power pumps mounted on one common drive shaft deliver all the fluid power required for the multiple operations of the Dixie-Dredge, a compact, portable dredge recently developed by the Service Machinery Corporation of North Miami, Florida.

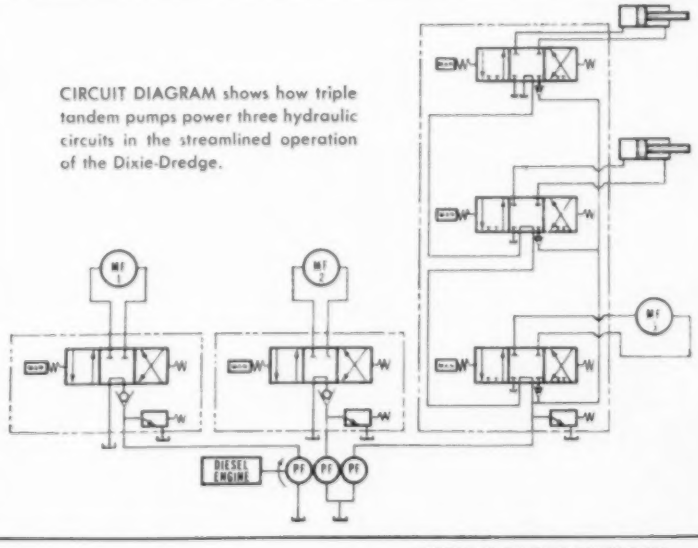
THREE OIL-HYDRAULIC CIRCUITS are powered by these triple tandem pumps operating at 1500 rpm at a relief valve pressure setting of 1500 psi. COMMERCIAL parallel circuit, 4-way, 3-position, directional control valves direct the flow of power to the COMMERCIAL motors and the cylinders.

Circuit diagram shows, in one oil-hydraulic circuit, motor No. 1, with an output of 14 hp, mounted at the underwater cutter head and driving it through a gear reducer. In another circuit, motor No. 2, which delivers 11 hp, rotates a winch used to swing the dredge and cutter head from side to side. The third circuit includes motor No. 3, with 11 hp output, connected to another winch used to raise or lower the ladder. All three motors rotate at 1000 rpm and operate at 1500 psi.

Parallel circuiting in the valve which controls motor No. 3 and the spud cylinders permits simultaneous operation of both the ladder and the spuds. Check valves, built into individual valve working sections, block the return flow from the cylinders and thus prevent load drop.

SPACE-SAVING FLUID POWER COMPONENTS proved to be the perfect answer for the compact, portable Dixie-Dredge. The COMMERCIAL triple tandem pumps, for example, take up little more space than one single pump. And the fluid power motors, valves and cylinders save on valuable space and eliminate connecting shafts, bearings, chains and sprockets because the hydraulic components are installed at their immediate points of operation and can easily be connected up—even piped to around corners. Savings on installation costs are obvious. So are savings on maintenance when you consider that fluid power transmission involves fewer wearing parts than equivalent mechanical power transmission.

OUR ENGINEERS CAN HELP YOU gain important savings like these in the design of *your* heavy duty equipment. Check with them for the best application of COMMERCIAL's complete line of fluid power units—pumps, valves, motors and cylinders. Address: Commercial Shearing & Stamping Company, Dept. A-40 Youngstown 1, Ohio.



CIRCUIT DIAGRAM shows how triple tandem pumps power three hydraulic circuits in the streamlined operation of the Dixie-Dredge.

COMMERCIAL
shearing and stamping

CIRCLE 35 ON TIME-SAVER CARD

T-J spacemaker cylinder

Quality Engineered

to give quality results

with Extras . . . at No Extra Cost!

You get more—much more—when you specify and use any of T-J's complete line of Spacemaker cylinders. The Spacemaker is engineered to give you better, more accurate, and longer service—offers, exclusively, many extras . . . that are STANDARD, AT NO EXTRA COST!

Designed to eliminate tie-rods, providing greater strength . . . saves space . . . reduces manhours and costs in all push-pull-lift operations. IMMEDIATE SHIPMENT in a wide range of styles and capacities, with 64,000 combinations. Write for Bulletin SM 155-3 with complete engineering details. The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON

METAL PISTON ROD SCRAPER . . . Standard at No Extra Cost!

NEW "SUPER" CUSHION FOR AIR . . . Standard at No Extra Cost!

CHROME PLATED CYLINDER BORES AND PISTON RODS . . . Standard at No Extra Cost!

ONE PIECE PISTON . . . Standard at No Extra Cost!

NEW "SELF-ALIGNING" MASTER CUSHION FOR HYDRAULIC USE . . . Standard at No Extra Cost!

NO TIE-RODS TO STRETCH . . . Standard at No Extra Cost!

STREAMLINED DESIGN . . . Oil Pressure to 750 P.S.I.—air to 200 P.S.I. Standard at No Extra Cost!

FORGED SOLID STEEL HEADS . . . Standard at No Extra Cost!

CIRCLE 124 ON TIME-SAVER CARD

NATIONAL OIL SEAL LOGBOOK

Ask yourself these questions when specifying oil seals

SHAFT RPM, FPM, RUNOUT, ENDPLAY	Is seal rated at or above my anticipated operating extremes? ☐ YES ☐ NO
TEMPERATURE, LUBRICANT TYPES	Will heat or special-purpose lubricants attack my sealing lip compounds? ☐ YES ☐ NO
PRESENCE OF DIRT OR OTHER FOREIGN MATERIAL	Point often overlooked. If present, should I specify dual-lip sealing member? ☐ YES ☐ NO
COST RELATED TO SEAL DESIGN	Will a simpler, less expensive seal do as good a job as a more sophisticated unit? ☐ YES ☐ NO
NEW SEAL DESIGNS AND MATERIALS ON MARKET	Are there new high temperature, high speed compounds I should examine before specifying? ☐ YES ☐ NO
SPECIAL DESIGNS FOR SPECIAL PROBLEMS	Not all sealing jobs can be met with stock seals. Do I need a special factory design? ☐ YES ☐ NO
DELIVERY, REPUTATION FOR QUALITY	Is my resource noted for on-time delivery, uniform quality, and good follow-up service? ☐ YES ☐ NO

Don't specify "blind." Your National Oil Seal Engineer has up-to-date data on seals—old, new and under development. He understands current sealing parameters; what special designs can probably be developed. His frank, free counsel can't help but lead to better sealing, faster assembly, simpler servicing, faster delivery or lower cost.

Call him today. Number's in the Yellow Pages, under Oil Seals.

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CIRCLE 88 ON TIME-SAVER CARD

Correct Lubrication in Action...

Production Increased

Removing plastic radio cabinet from an injection press. Santay Corporation pioneered in plastics technology, creating special machinery and processes. From here, intricate, highly finished plastic products are furnished to America's most prominent appliance manufacturers.

Mobil

Complete Engineering Program
Proved Petroleum Products

Mobil

SOCONY MOBIL OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

27.1% *no additional capital investment!*

Santay Corporation finds new ways to increase production of plastics products with the help of Socony Mobil

Competition is at its fiercest in the plastics business. Any unnecessary overhead costs can cut the heart out of profits. For this reason Santay management continually looks long and hard for ways to cut downtime, increase production.

In 1954 a Mobil Correct Lubrication Program was installed throughout the plant. This comprehensive engineering service had these results, according to Santay's plant engineer: "The reduction in downtime, three years after the Mobil program started, accounted for 27.1% increase in production *with no additional capital investment.*"

This outstanding result was achieved by close cooperation between Santay plant personnel and Mobil. Press operations were closely studied . . . lubrication procedures constantly improved . . . records prepared to show downtime and service frequency on every machine . . . cleanliness of lubricant carefully watched. All this help is *yours* when you rely on Mobil. Why accept less?

Problem: Downtime on a key press could result in a loss of $250 per hour in product sales. *Cause:* Maintenance follow-through not fully developed. *Solution:* Plant-wide Mobil Program that cut downtime over 25% in first year.

Oil Control saves 40% on oil purchases. Under Mobil Program, hydraulic oil is reconditioned . . . oil checked regularly for viscosity and contamination. *Result:* Oil purchases kept to minimum, maximum machine protection assured.

Problem: Matching molds on injection press worked out of alignment. *Cause:* Excessive wear on toggle pins and bushings. Lubricant didn't stick to wear surfaces. *Solution:* Mobil recommended oil that "stays put" . . . avoided $800 shutdowns.

Cost Control: Every machine has its control card. Alert watch is kept for press slowdowns, high maintenance. As a result, Santay maintenance personnel with Mobil assistance can move quickly to keep production high, costs low.

Correct Lubrication

Another reason You're Miles Ahead with Mobil!

NEW Nickel-Plated Brass *Fulflo Filter* for Compressed Air

This new compressed air Fulflo Filter (B-R) is made of gleaming nickel-plated brass . . . sanitary and non-rusting. 7-inch Honeycomb Filter Tubes minimize gumming — remove moisture, oil, microscopic dust, rust, dirt, and scale. Flow rate is as high as 76 cfm of free air at operating pressure of 100 psi. ⅜ or ¾ inch N.P.T.

For a new catalog on Fulflo Filters for compressed air, CO_2 and other gases, write to Department AH.

Single Tube Fulflo Filters

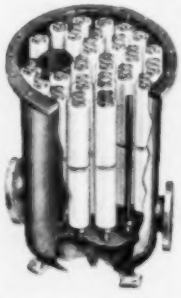
B-A model has 3, 5 or 7-inch Honeycomb Filter Tubes for 10, 30 and 60 cfm at operating pressures up to 125 psi. AF model has flow rate of 60 cfm at operating pressures up to 250 psi. ⅜ inch NPT.

Hi-Pressure Fulflo Filter

Tested at hydrostatic pressure of 8,000 psi, this filter withstands operating pressure up to 4,000 psi. 7-inch Honeycomb Filter Tubes for 1.5 cfm at 4,000 psi (equivalent of 410 cfm of free air).

Multi-Tube Fulflo Filter

For high flow rates or central installations. Three, six, twelve, or eighteen Honeycomb Filter Tubes in parallel. Steel-and-iron, stainless steel, or nickel-plated brass containers. For 1½ and 2-inch pipes. Operating pressure up to 100 psi.



Hi-Capacity Fulflo Filters

This rugged filter is made in 10 sizes — from 22 to 270 10-inch Honeycomb Filter Tubes in parallel. Sturdy welded steel construction — 304 or 316 stainless steel to order. For 3, 4, and 6-inch pipes. 100 psi operating pressure.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

CIRCLE 34 ON TIME-SAVER CARD

Ralph J. King
Director

Robert Q. Sharpe
Associate Director

14th National Conference Industrial Hydraulics

Raymond D. Meade
Secretary

A MOST timely feature of this year's NCIH will be a report on the activities at the Air Force Missile Test Center. Hydraulics in space flight is another very timely subject on the program.

The two-day session, October 16 and 17, at Chicago's Sherman Hotel will have 25 papers on latest applications of hydraulics and pneumatics in a number of industries.

Organizations sponsoring the NCIH are: Illinois Institute of Technology and Armour Research Foundation of Illinois Institute of Technology with the cooperation of the NFPA and the Illinois and Chicago chapters of many national engineering societies. Purpose of these conferences, started in 1945, is the exchange of information on latest developments in the fluid power field.

Director of the 14th Conference is Ralph J. King, Staff Engineer, Caterpillar Tractor Co. Associate Director is Robert Q. Sharpe, Chief Engineer-Industrial, Socony-Mobil Oil Co. Raymond D. Meade of Illinois Tech is Conference Secretary.

Program and abstracts of the Conference papers are given on the following pages. Although brief, the abstracts give valuable information to those unable to attend.

PROG

NATIONAL CONFERENCE ON (N

B. R. Teree
Chairman
Aircraft Systems

F. L. Mackin
Chairman
Automotive

A. S. Morrow
Chairman
Hydraulic Fluids

M. G. Sulser
Chairman
Presses

J. J. Pippenger
Chairman
Components and
Accessories

F. R. Swanson
Chairman
Automatic Machine Tools

Duncan Gardiner
Chairman
Servomechanisms and
Systems

Maj. Gen. D. N. Yates
"Problems and Progress
in Testing
Long Range Missiles"

THURSDAY, OCTOBER 16, 1958

8:00 A. M. Registration: Sherman Hotel, Chicago

9:00 A. M. GENERAL SESSION

Opening: Ralph J. King, Staff Engineer, Caterpillar Tractor Co., Conference Director

1) Presentation of awards to winners of APPLIED HYDRAULICS & PNEUMATICS 1958 PRIZE PAPER CONTEST by Paul Rolnick, Editor and Publishing Director, Industrial Publishing Corporation Cleveland.

Chairman: R. Q. Sharpe, Chief Engineer, Industrial Socony-Mobil Oil Company.

1) "Problems and Progress in Testing Long Range Missiles", Major General D. N. Yates Commander, Air Force Missile Test Center, Patrick Air Force Base, Florida.
2) "Hydraulics in Space Flight", Kurt Stehling, Head of Propulsion, Project Vanguard, Naval Research Laboratory, Washington.

12:15 P. M. LUNCHEON

2:00 P.M. AFTERNOON TECHNICAL SESSIONS (all held simultaneously)

Aircraft Systems

Chairman: B. R. Teree, Vice President, Greer Hydraulics, Inc.

1) "Design Features of the Crusader Hydraulic System", J. H. Ballantoni, Staff Hydraulic Engineer, Chance Vought Aircraft, Inc., Dallas, Tex.
2) "Aircraft Hydraulic Component Design and the Use of Analog and Digital Computers", Carl Goth and Carl Potter, Vickers Inc., Administrative and Engineering Center, Detroit.
3) "Research on High Temperature Hydraulic and Pneumatic Systems for Aircraft", Charles H. Cannon, Manager, Mechanical Systems, Lockheed Aircraft Corp., Georgia Div. Marietta, Ga.

Automotive

Chairman: F. L. Mackin, Chairman, Machine & Wood Shops & Hydraulics, General Motors Institute.

1) "Air—Its Application to Automotive Suspensions", C. N. Reuter, Supervisor, Ride and Handling Section, Ford Car Engineering, Ford Motor Co., Dearborn, Mich.
2) "Hydropneumatic Vehicular Suspension Design Theory and Operational Considerations", Franklin O. Wisman, Assistant Chief Engineer, New Devices Engineering and Arnold W. Nordgren, Project Engineer, New Devices Engineering, Bendix Products Div., Bendix Aviation Corp., South Bend.

GRAM

ON INDUSTRIAL HYDRAULICS

Hydraulic Fluids

Chairman: A. S. Morrow, Staff Engineer, Shell Oil Company.
Seminar: "Good Design Plus Proper Fluid and Maintenance Equals Optimum Performance".

1) "The Performance of Hydraulic Equipment and Fluids as Experienced by the Hoover Company", K. W. Zintz, Hoover Co., N. Canton, Ohio.
2) "Responsible Engineering for Performance and Maintenance", William Van Horn, Chief Engineer, Hydraulic Power Div., The Hydraulic Press Manufacturing Co., Mount Gilead, Ohio.
3) "Application of Hydraulics in the Multi-Spot-welding of Automobile Bodies", W. E. Adamek, General Offices, Fisher Body Div., General Motors Corp., Detroit.
4) "Bonus Factors in the Use of Hydraulic Oils", W. J. Varetoni, Cities Service Oil Company, New York.
4) "Effects of Design on Maintenance of Hydraulic Systems", William F. Bohannan, Supervisor Product Improvement Engineering, Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio.

Presses

Chairman: M. G. Sulser, Regional Sales Manager, Denison Engineering Div.

1) "The Standardization of Hydraulic Machinery Based on ASA—Z 17.1 Preferred Number Series", W. R. Jackson, Chief Engineer, Fordees Corp., Leetonia, Ohio.
2) "Hydraulic Circuit for Compacting Press", John J. Littley, Asst. Manager, Presses, Hamilton Division, Baldwin-Lima-Hamilton Corp., Hamilton, Ohio.

6:30 P. M. ALL SOCIETY BANQUET

FRIDAY, OCTOBER 17

9:00 A. M. MORNING TECHNICAL SESSIONS
(all held simultaneously)

Components and Accessories

Chairman: J. J. Pippenger, Vice President and Chief Engineer, Double A Products Co.

1) "Extended Service Life Solenoids", E. A. Viale, Vice President, Detroit Coil Co., Ferndale, Mich.
2) "Investigation of the Performance of a Pressure Compensated Flow Control Valve", Dennis W. Prosser, Mechanical Engineering Department Illinois Institute of Technology, Chicago.

Pneumatics

Chairman: R. J. Bailey, Manager, High Pressure Pneumatics, Cardox Corp.

1) "Water and Oil Removal from High Pressure Gases", J. C. Hesson, Assistant Director of Research, Cardox Corp., Chicago.

Pumps

Chairman: Ernst Wiedmann, Chief Engineer, The Oilgear Co.

1) "New Horizons in Vane Pump Design", E. I. Brown, Director of Engineering, Machinery, Marine and Ordnance Division and Raymond Pettibone, Staff Engineer, Research and Development, Vickers Inc.
2) "High Pressure Pumps and Their Applications", Darby B. Neff, Supervisor, Product Development, Denison Engineering Division, American Brake Shoe Company, Columbus, Ohio.

12:15 P. M. LUNCHEON

2:00 P.M. AFTERNOON TECHNICAL SESSIONS
(all held simultaneously)

Automatic Machine Tools

Chairman: F. R. Swanson, Chief Engineer, Sundstrand Machine Tool Co.

1) "The Selection and Evaluation of a Hydraulic System for a Numerical Contouring Control", George Carroll, Project Engineer, Development Research Department and Herbert Fuldner, Supervisor, Electro-Hydraulic and Gaging Div., The Cincinnati Milling Machine Co., Cincinnati.
2) "A Hydraulic Servo Drive for a Numerically Controlled Positioning System", Justin P. Wright, Project Engineer, Jones and Lamson Machine Co., Springfield, Vt.

Mobile Equipment

Chairman: V. P. Donner, Chief Engineer, Hydraulics, International Harvester Co.

1) "Hydraulics on the Four-In-One Loader", Edward Drott, President and Philip Pueschner, Project Engineer, Drott Manufacturing Corp., Wausau, Wis.
2) "Hydraulic Applications in Modern Fire Apparatus", William B. Pashkow, Assistant to Vice President, Administration, Mack Trucks Inc., Sidney, Ohio.

Servomechanisms and Systems

Chairman: Duncan Gardiner, Director, Research & Development, Vickers Inc.

1) "Application of an Electro-Hydraulic Servo-Valve to Auxiliary Power Supply Regulation", Murray Goldman and Marvin R. Gore, Research Department, Avionics Div., Aerojet-General Corp., Azusa, Calif.
2) "The Hydraulic Servo and Tape Controlled Machine Tools", Robert K. Sedgwick, Assistant Chief Engineer, Servo Machine Tool Div., Kearney and Trecker Corp., Milwaukee, Wis.

These abstracts were written by speakers at the NCIH for quick reference. Complete Conference Proceedings will be published in a bound volume early in 1959.

summaries of

TECHNICAL PAPERS

presented at the 14th N C I H

GENERAL SESSION

• PROBLEMS AND PROGRESS IN TESTING LONG RANGE MISSILES

by Maj. Gen. Donald N. Yates, Commander, Air Force Missile Test Center, Patrick Air Force Base.

A brief description of the Air Force Missile Test Center and its activities includes some basic concepts and philosophy involved in testing long range missiles. For each test specific objectives are established. Whether or not these objectives are achieved is the criterion of success or failure, rather than the apparent missile performance and distance covered. Complex nature and enormous size of the physical layout necessary for testing missiles will be described. This includes facilities on the Florida mainland and a chain of islands extending southeastward for five thousand miles to the South Atlantic Ocean off the coast of Africa. Slides of typical down-range stations used in missile testing will be shown, as well as movies of several so-called "unsuccessful" and successful launchings of missiles.

• HYDRAULICS IN SPACE FLIGHT

by Kurt Stehling, Head of Propulsion, Project Vanguard, Naval Research Laboratory.

A description of hydraulic application and the utilization of fluid power in existing missiles. This will include some discussion of the general use of hydraulics in connection with launching equipment. Potential application of hydraulic actuation for advance space missions in the future will also be discussed.

AIRCRAFT SYSTEMS

• DESIGN FEATURES OF THE CRUSADER HYDRAULIC SYSTEM

by J. H. Ballantoni, Staff Hydraulic Engineer, Chance Vought Aircraft, Inc.

Hydraulic design features of the Chance Vought Aircraft F8U-1 Crusader, Navy fighter airplane. The three independent hydraulic systems and their basic functions will be outlined. Only the utility hydraulic system will be discussed in detail, covering airplane components operated, the basic functions they serve, and pointing out the detail hydraulic system design features.

Kurt Stehling

Carl Potter

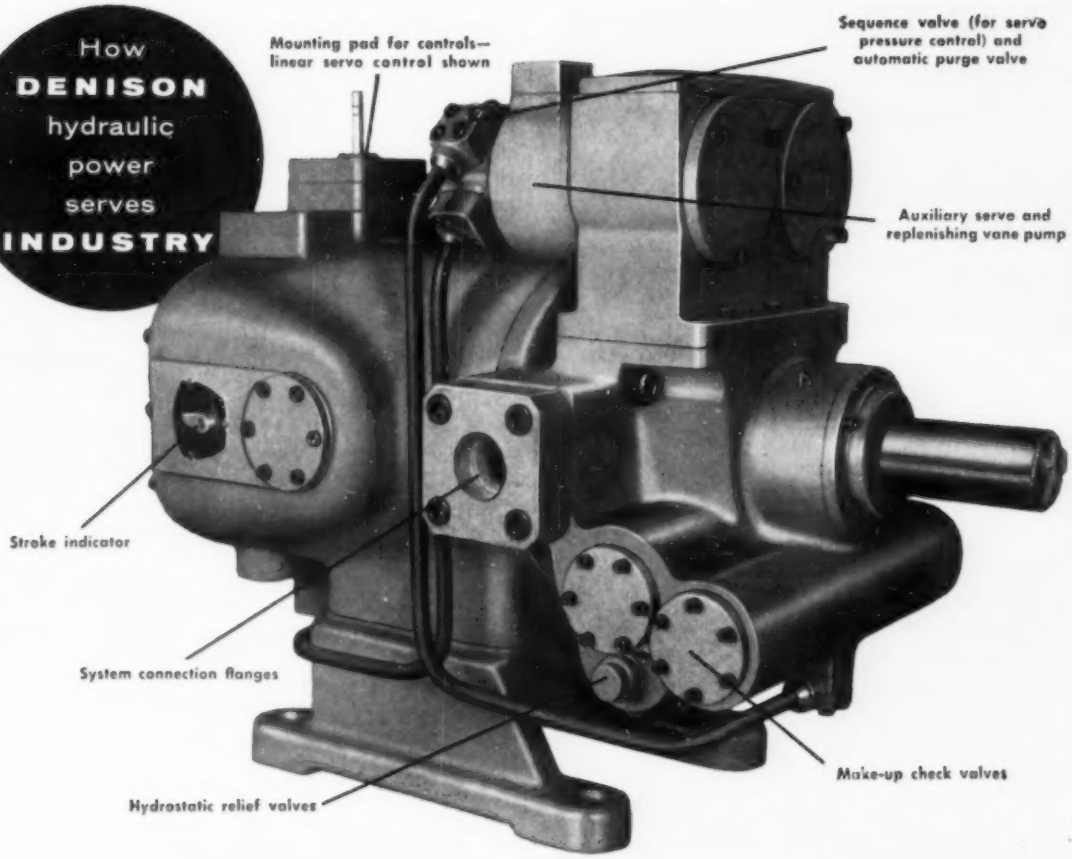
• AIRCRAFT HYDRAULIC COMPONENT DESIGN AND THE USE OF ANALOG AND DIGITAL COMPUTERS

by Carl Goth and Carl Potter, Vickers, Inc.

A general discussion of Analog and Digital Computer techniques applied to the component design process. Two examples illustrate the techniques employed and demonstrate the satisfactory correlation obtained between computer predictions and laboratory results. They are: 1. Analog computer simulation (and the corresponding experimental results) of response in terms of time to typical demands on a variable delivery piston pump. 2. Use of a digital computer for determining the optimum metering means

Continued on page 92

How DENISON hydraulic power serves INDUSTRY


Mounting pad for controls—linear servo control shown
Sequence valve (for servo pressure control) and automatic purge valve
Auxiliary servo and replenishing vane pump
Stroke indicator
System connection flanges
Make-up check valves
Hydrostatic relief valves

AXIAL PISTON PUMPS and MOTORS

For precision, split-second control of speed... torque... reversal... acceleration... deceleration

Series 30, 40 and 60

Constant and Variable Volume Pumps to 115 gpm

Fluid Motors to 373 inch-pounds per 100 psi

...for continuous service up to 3500 or 5000 psi

Denison's heavy-duty line of hydraulic Axial Piston Pumps and Motors offers important features and performance characteristics unexcelled in the hydraulic equipment field.

These Variable Volume Pumps are available as pre-built packages with built-in replenishing pump that provides supercharging . . . pressure control and forced circulation for cooling . . . plus relief and replenishing valves.

Axial Piston Pumps and Fluid Motors by Denison assure the kind of smooth, split-second, dependable operation required in today's most modern systems.

APPLICATIONS – Presses . . . transmissions . . . marine drives . . . missile ground support and handling equipment.

SPECIFICATION DATA

SERIES 30	SERIES 40
Constant and Variable Volume Pumps	**Constant and Variable Volume Pumps**
1200 rpm 3500 psi delivers 38 gpm	1200 rpm 3500 psi delivers 55 gpm
Fluid Motors	**Fluid Motors**
Torque—123.6 inch-pounds per 100 psi	Torque—179.7 inch-pounds per 100 psi

SERIES 60

Constant and Variable Volume Pumps

1200 rpm – 3500 psi delivers 115 gpm

Fluid Motors

Torque – 373 inch-pounds per 100 psi

OPERATING EFFICIENCY – Over-all mechanical efficiency at full load – 92%, Volumetric efficiency – 96%.

Other models for 5000 psi duty are available

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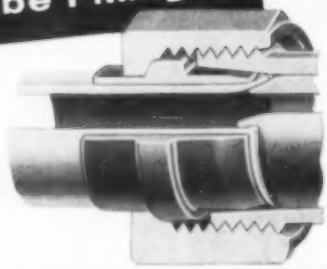
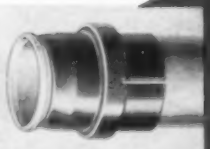
PUMPS • MOTORS • CONTROLS

Reduce Installation and Replacement Costs ...Prevent Leakage with

FLODAR Self-Flaring Tube Fittings





- Eliminates flaring, threading and soldering.
- Cannot be damaged by over-tightening.
- "Rock-bottom" stop signals that joint is sealed.
- Provides positive, leak-proof seal.

One piece chrome-moly patented steel sleeve forces the tube end into the connector body automatically forming a pressure-tight seal on both the OD and ID of the tube. The slotted rear of the sleeve grips tube against vibration.

■ FLODAR self-flaring tube fittings eliminate time-consuming preparatory operations such as flaring, brazing, welding or soldering. Tubing costs are reduced because heavy wall tubing is not needed to assure a good joint. Even inexperienced assemblers can make a leak-tight joint every time.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage and damage to tube and fitting.

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- No-Flare & Flare-Type Fittings
- High Pressure Pipe Fittings
- Straight Thread Tube Fittings
- Metal-to-Metal Porthole Fittings
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SUMMARIES OF NCIH PAPERS

for a piston pump. Pressure rise and decay characteristics of the valving (commutation) between cylinder block and valve plate are important factors in regard to noise and outlet pulsation.

• RESEARCH ON HIGH TEMPERATURE HYDRAULIC AND PNEUMATIC SYSTEMS FOR AIRCRAFT

by Charles H. Cannon, Lockheed Aircraft Corp.

Georgia Division of Lockheed has been engaged in high temperature work for three years. One research program has been the development of a 5000-psi, 1000-F pneumatic servo system. Considerable progress has been made in developing a pneumatic servo which is stable and capable of operating at 1000 F. Another research program has been the development of a 700 F, 4000-psi hydraulic system. The temperature of hydraulic systems is restricted due to the inability of fluids to operate satisfactorily. The Convair B-58 bomber employs heat exchangers to lower the hydraulic fluid temperature to 350 F. The new North American B-70 will probably employ heat exchangers to restrict fluid temperature to 500 F. A system to withstand higher temperature would save considerable weight by eliminating heavy heat exchangers.

AUTOMOTIVE

• AIR — ITS APPLICATION TO AUTOMOTIVE SUSPENSIONS

by C. N. Reuter, Supervisor, Ride and Handling Section, Car Chassis Engineering Department, Ford Div. Ford Motor Co.

Very soft springing has long been recognized as a most effective means of providing the ultimate, "floating on a cloud" type of ride. This can be achieved by using soft, low rate chassis springs, and, in general, automobiles have been tending toward the softer, lower frequency ride for the past 30 years. However, with steel springs, this produces severe bottoming and impact on rough roads, and other not-so-good results. Air springs and leveling system used in the 1959 Ford are described along with the effect of the various design parameters that entered into the air spring design. The purpose and function of each part of the leveling system is also described. This new suspension results in a very significant improvement in ride by combining the soft boulevard ride with oustanding rough road ride characteristics.

• HYDROPNEUMATIC VEHICULAR SUSPENSION DESIGN THEORY AND OPERATIONAL CONSIDERATIONS

by Arnold W. Nordgren, Project Engineer, and Franklin O. Wisman, Assistant Chief Engineer New Devices Engineering, Bendix-Products, Bendix Aviation Corp.

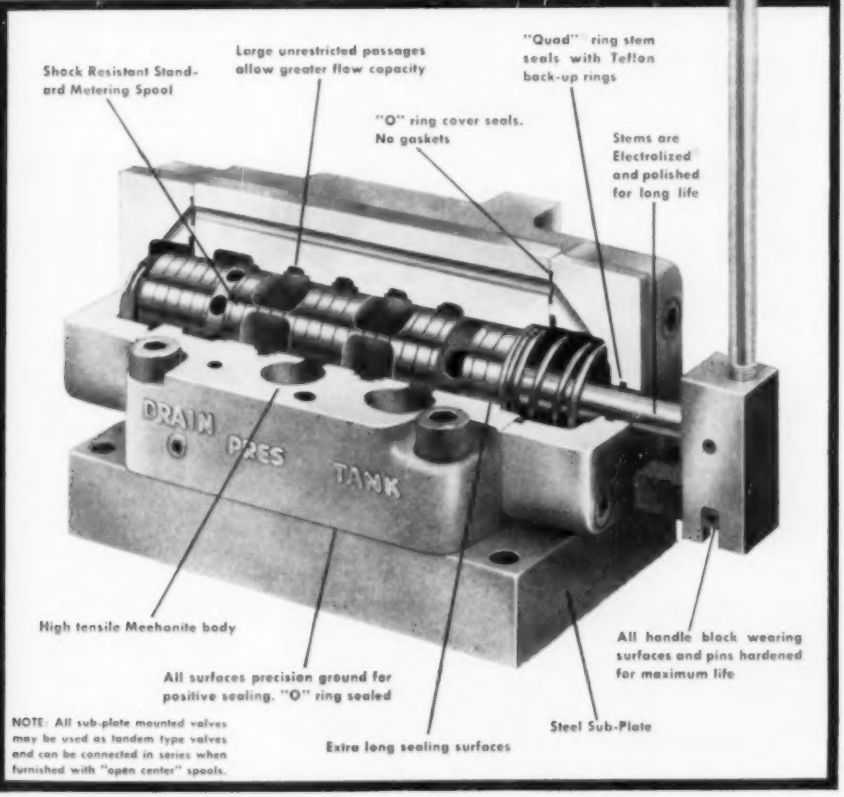
Demands for improvement in the riding comfort of automobiles have led to the use of progressively lower

Continued on page 94

Rivett announces a new line of

HYDRAULIC VALVES

3000 PSI; sub-plate mounted; manually operated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Large unrestricted passages allow greater flow capacity
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PRES
TANK
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Extra long sealing surfaces
NOTE: All sub-plate mounted valves may be used as tandem type valves and can be connected in series when furnished with "open center" spools.

Reliable performance through precision manufacturing

Rivett Series 6100 Hydraulic Valves are the latest in design, furnishing accurate, positive control of hydraulic power. Developed by engineers long experienced in fluid power, these valves offer economical, efficient operation as well as trouble-free maintenance and long-life. Featuring unrestricted passages to permit greater flow capacity, the 1" size in the Series 6100, for example, is rated at 28.2 gpm at 15 ft. per sec. Piston action is noted for smooth, positive opening and closing.

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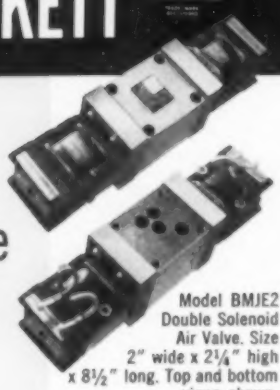
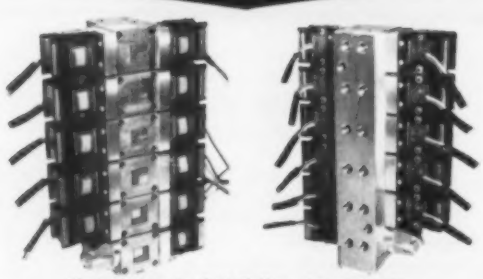
Hi-Cyclic
Small size high performance air and hydraulic valves for manifold mounting
(Note Valve Sizes)



Model BMJE2 Double Solenoid Air Valve. Size 2" wide x 2¼" high x 8½" long. Top and bottom views shown.

Model BMJE1 Single Solenoid Hydraulic Valve. Size 2" wide x 2¼" high x 7¼" long.

Provide extremely compact multiple valve installation with common subplate for automation controls on specialized machine tools and other production equipment.



Typical six valve installation—top and bottom views shown. Block is 12½" long.

- Valves mount on 2" centers.
- Up to 6 units on one manifold.
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CIRCLE 19 ON TIME-SAVER CARD

SUMMARIES OF NCIH PAPERS

springing rates. Two factors limit the extent to which the rate of metallic springs may be reduced: first, the detail design and physical size of the spring become difficult, and second, leveling of vehicle height with varying load becomes essential. Superior elastic properties of gases are well known and it is only natural that inventors should apply them to vehicular springs. Operation is described in simple terms and design equations are derived for both air and hydropneumatic suspensions. Practical considerations influencing design and application are discussed.

HYDRAULIC FLUIDS

• THE PERFORMANCE OF HYDRAULIC EQUIPMENT AND FLUIDS AS EXPERIENCED BY THE HOOVER CO.

by K. W. Zintz, The Hoover Co.

Fluids play a major role in good hydraulic machine performance. There are many fluids of different types and viscosities on the market today with prices ranging from a few cents a gallon to twelve dollars a gallon. High priced fluids are not necessarily the best ones for a machine from an economic as well as a performance stand point. There are other factors to consider such as pressures, operating temperatures, length of time the pump is under load, plus numerous other operating conditions along with the manufacturer's recommendations. The utmost care is required in selecting the correct fluid for a machine when synthetic fluids are to be used. Scheduled, or preventive maintenance is important to keep machines in operation with a minimum of unscheduled repairs. Scheduling of regular inspections for oil levels, oil appearance, leaks, pump performance, lubrication, etc. can save many dollars in major repair bills and oil purchases. Such a planned program can help to improve machine and plant appearance.

William E. Adamek

W. F. Bohannan

• APPLICATION OF HYDRAULICS IN THE MULTI-SPOTWELDING OF AUTOMOBILE BODIES

by William E. Adamek, Senior Production Engineer, Fisher Body Div., General Motors Corp.

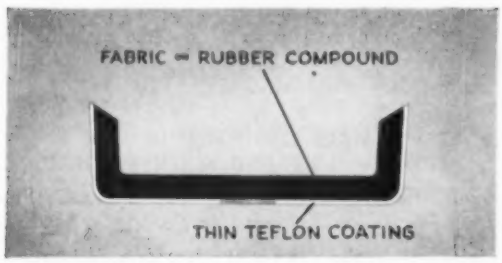
Fabrication of modern automobile bodies from formed sheet steel components depends on multi-spot-

Continued on page 96

NEWEST OF THE GARLOCK 2,000

First Advance in Cup Design in 30 Years

New Garlock TEFLON-Coated Cups



Cutaway shows how TEFLON coating is applied to outer surface of molded cup by special Garlock process. Coating becomes integral part of outer surface.

This exclusive Garlock development will substantially improve the operation of your hydraulic or pneumatic equipment.

TEFLON-coated cups reduce the breakaway torque required to operate cylinders; reduce running friction; will not stick to cylinder walls even after long periods of idleness. Completely eliminate "squealing." All this, of course, results in longer life, less downtime.

TEFLON, with its low coefficient of friction and anti-sticking characteristics, has for many years resisted the efforts of manufacturers to use it as a coating. The very anti-sticking qualities that make it desirable, also made it difficult to work with. Now Garlock has perfected a technique for coating molded cups with a thin layer of TEFLON. This coating becomes an integral part of the cup.

Most important, of course, TEFLON-coated cups are low in cost, only slightly higher than ordinary cups.

Get full information on this newest member of "the Garlock 2,000" . . . two thousand styles of packings, gaskets, and seals for every need. Call your local Garlock representative or write for Folder 145. You'll find information on other Garlock products in Sweet's Product Design File.

Other New Garlock TEFLON-Coated Products

To reduce friction and reduce downtime at low cost on applications using V-type packings or O-rings Garlock also furnishes TEFLON-coated CHEVRON* packing and TEFLON-coated O-rings. Both have the same exceptional anti-friction qualities of TEFLON-coated cups. These products are available in all the standard sizes. Write for CHEVRON folder AD-115; or O-Ring Folder AD-148.

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HOKE

SEE NEXT PAGE FOR INSIDE STORY ON THIS VERSATILE NEW VALVE!

CIRCLE 65 ON TIME-SAVER CARD

SUMMARIES OF NCIH PAPERS

welding to make such fabrication economical. The Fisher Body Div. of General Motors Corp. is responsible for the fabrication of all multi-spotwelded body components used on GM cars. They use hydraulically-actuated multi-spotwelding tools. Since waterbase fire-resistant hydraulic fluids are used exclusively as the power medium in the hydraulic systems, this paper deals with certain basic concepts, dictated by experience, which had to be incorporated in the design of hydraulic power units and in the hydraulic circuitry to provide low fluid sump operating temperatures and satisfactory fluid and pump life.

• BONUS FACTORS IN THE USE OF HYDRAULIC OILS

by W. J. Varetoni, Cities Service Oil Co.

Selection of the proper type of hydraulic fluid and proper maintenance offers a simple, effective and economic way to get troublefree hydraulic operation. The primary function of a hydraulic machine is, of course, to deliver the required amount of hydraulic energy through the circuit to the object it is intended to operate. The hydraulic oil's capacity for the continued performance of this function is based upon a number of factors: design, quality and condition of the oil, mechanical condition including seals, operating limitations and severity of service. Assuming the design and the installation of the hydraulic system is good, the oil and its maintenance becomes the variable which determines whether or not the machine gives good service and has long life. The value of quality oils and their maintenance is described.

• RESPONSIBLE ENGINEERING FOR PERFORMANCE AND MAINTENANCE

by W. Van Horn, Chief Engineer, Hydraulic Power Div., The Hydraulic Press Mfg. Co.

This paper will point out the factors a designer must analyze in order to select the proper fluids, packings and components. Problems encountered by designers and maintenance people with present day fluids will be discussed. A summary will be made of pump, valve and cylinder components available on the market today. Also, a survey of an industrial plant for the determination of maintenance problems encountered with components generally, and the application of fluid mediums.

• EFFECTS OF DESIGN ON MAINTENANCE OF HYDRAULIC SYSTEMS

by William F. Bohannan, Supervisor Product Improvement Engineering, Denison Engineering Div., American Brake Shoe Co.

When designing a hydraulic system, primary consideration should be given to obtaining a unit that will give maximum reliability with a minimum of down time for service and periodic maintenance. For this reason, the ideal system should have circuit components that are readily available for replacement, inspection, and servicing when the occasion arises. An-

other factor which affects system design is the fluid to be used. Use of hydraulics in hazardous locations has brought about the development of a number of fluids which are classed as fire-resistant or non-flammable. These fluids have physical properties which vary widely from the commonly used petroleum-base hydraulic oils. Most of the pumps and valves in use today were designed for use with the petroleum base oils. This difference in the properties of the fire resistant fluids should have a great effect on both the design and maintenance of hydraulic systems. From the pump builder's viewpoint, it is very necessary to consider fluids as well as maintenance in the design of complete hydraulic systems.

PRESSES

• THE STANDARDIZATION OF HYDRAULIC MACHINERY BASED ON ASA — Z 17.1 PREFERRED NUMBER SERIES

by W. R. Jackson, Chief Engineer, Fordees Corp.

A brief survey of the proposed hydraulic standards by NMTBA. Shortcomings of the proposal will be analyzed from the standpoint of economy, engineering development, user and supplier. Lack of mathematical background will not allow use of the proposal as a guide for future development trends and industry demands. Laws governing the natural growth of all things have not been applied. Non-uniform spacing of proposed press capacities and sizing of various press elements will not permit creation of a uniform system. Possible solutions are discussed and shortcomings of various systems are shown. The most promising decimal-geometrical growth progression known as preferred number series is analyzed and a unified and universally applicable hydraulic standarization system developed, allowing the tie-in of all the required basic standards into one integral package.

W. R. Jackson

Dennis Prosser

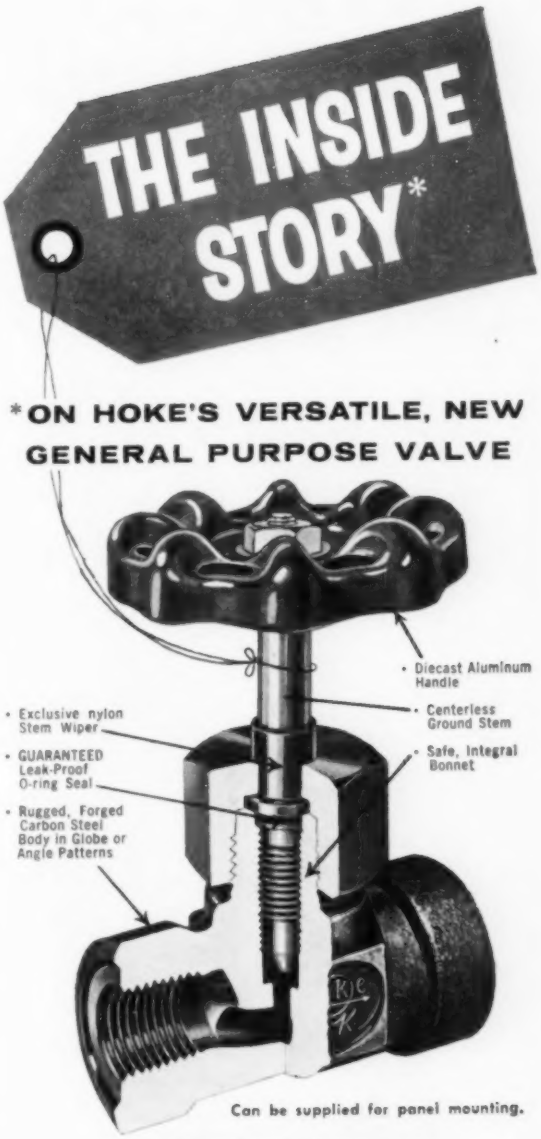
COMPONENTS AND ACCESSORIES

• EXTENDED SERVICE LIFE SOLENOIDS

by E. A. Viale, Vice President, Detroit Coil Co.

Efficient use of machinery calls for long life of the automated accessory equipment to reduce down time.

Continued on next page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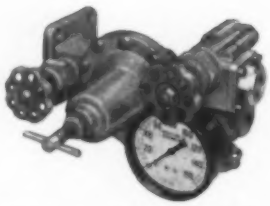

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SUMMARIES OF NCIH PAPERS

Life expectancy demands of accessory items—once 500,000 to 1,000,000 cycles—ranges from 6,000,000 cycles up. Life expectancy requirements for valve solenoids can be met at a reasonable cost by operating the solenoid in an oil bath. Operation of solenoids in an oil bath and the benefits derived from this design will be discussed.

• *INVESTIGATION OF THE PERFORMANCE OF A PRESSURE COMPENSATED FLOW CONTROL VALVE*

by Dennis W. Prosser, Mechanical Engineering Department, Illinois Institute of Technology

This paper presents some of the analytical and experimental results which were obtained from an investigation of the steady state performance of an industrial-type, pressure-compensated, flow-control valve. The main objective was to investigate the pressure-versus-flow characteristics of the valve and to explain any departure from the desired performance. Factors such as viscosity variation and transient phenomena were held to a minimum in order to reduce the variables involved. The problem is defined, and a brief resume is given of the analytical approach. Both analytical and experimental results are presented to indicate the degree of correlation obtained. The bulk of the discussion concerns the results and conclusions that were obtained. In particular, the influence of flow-induced (momentum) forces is considered.

PNEUMATICS

• *WATER AND OIL REMOVAL FROM HIGH PRESSURE GASES*

by Dr. J. C. Hesson, Ass't. Director of Research, Cardox Corp.

The Missile Program requires air and other gases at pressures up to 10,000 psi with dewpoints of lower than —85 F with oil content less than 5 parts per million. This paper deals with some of the problems encountered in the removal of water and oil from high pressure gases with particular emphasis on the use of a mechanically refrigerated separator. Desiccant or absorbent driers are widely used as the sole means to remove water and oil vapor from high-pressure gases. However, the life of the driers is short, because of the large amount of water vapor present in the warm incoming gas. The use of refrigeration to cool the high-pressure gas and cause the vapors to condense ahead of the driers greatly increases desiccant life.

PUMPS

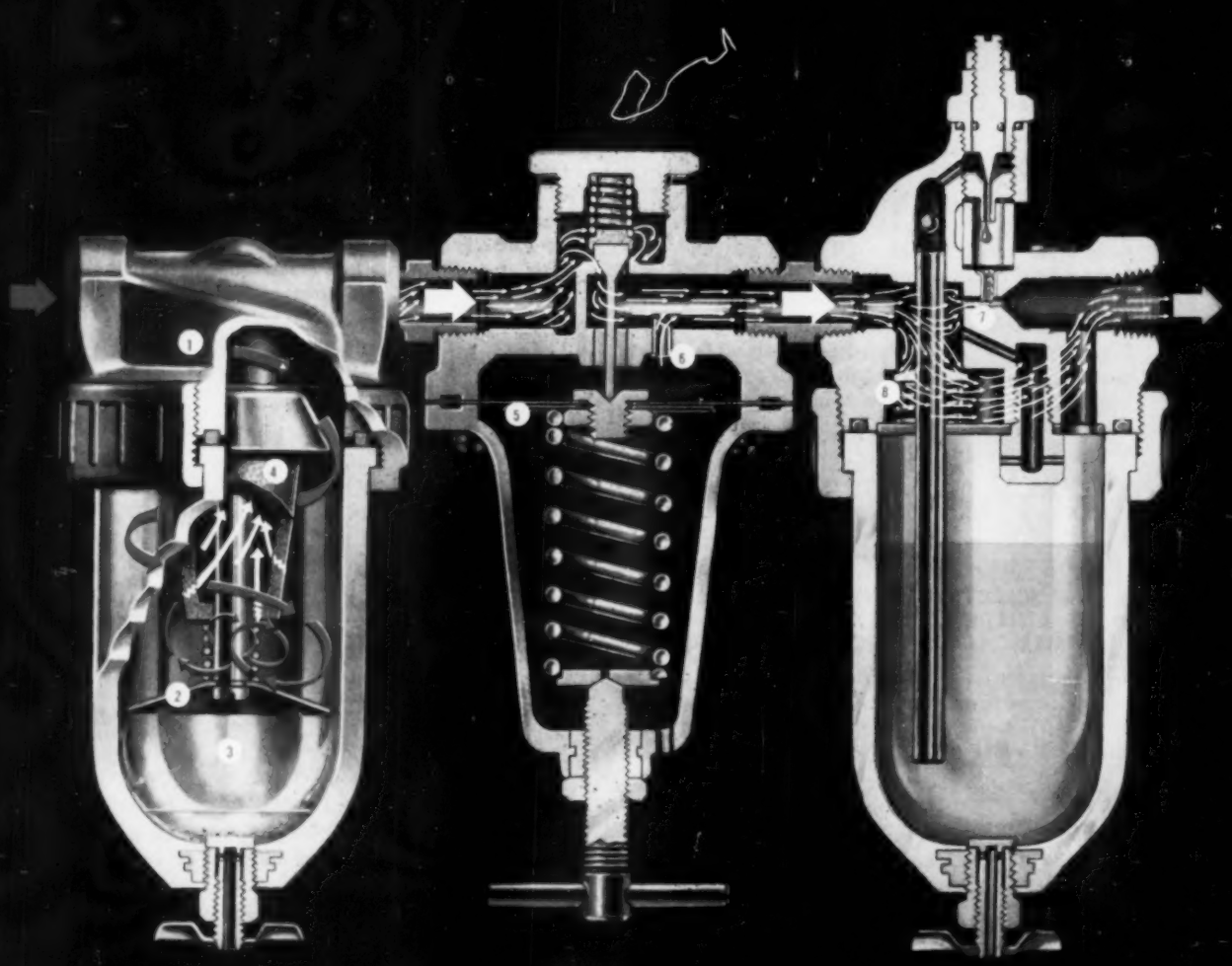
• *NEW HORIZONS IN VANE PUMP DESIGN*

by E. I. Brown and R. B. Pettibone, Vickers Inc.

Since the balanced vane pump was first introduced in 1928, it has been widely used wherever hydraulic power is required. These pumps were used initially

Continued on page 100

CIRCLE 134 ⟶



Curved inlet ❶ directs incoming air in downward helical pattern. Larger impurities and condensate are "thrown out" by centrifugal action, collecting on bowl sides and spiraling downward past baffle ❷ into quiet chamber for draining off. Baffle traps sediment in quiet chamber ❸ and allows only dry air centrifugally cleaned of larger impurities to reach porous bronze filter element ❹ where finer particles are filtered out.

Diaphragm of large area ❺ is of BUNA-N—imparts extra sensitivity for response to even minute reduced pressure variations. Aspirator ❻ acts directly on diaphragm, providing instant compensation for fluctuating loads . . . assures precise control and stabilizes pressures reaching individual pieces of equipment.

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ing device. First, some means for amplifying the low

trol valve by adding three relief valves reduced the

in the machine tool industry where speeds and pressures normally did not exceed 1800 rpm and 1000 psi respectively. As power hydraulics began to spread to other fields (such as road and farm machinery with their more varied demands), both speeds and pressures started to climb and initial cost of the hydraulic equipment entered the picture strongly. Thus there was a need for pump designs more favorable from a high production standpoint; yet capable of meeting more rigorous efficiency requirements than heretofore encountered. This paper deals with some of the problems encountered during this development period and their solutions.

AUTOMATIC MACHINE TOOLS

• THE SELECTION AND EVALUATION OF A HYDRAULIC SYSTEM FOR A NUMERICAL CONTOURING CONTROL

by George Carroll, Project Engineer, Development Research Department and Herbert Fuldner, Supervisor, Electro-Hydraulic and Gaging Division, The Cincinnati Milling Machine Co.

Unique features of the Cincinnati Numerical Contouring Control System, system operation and background are covered. The requirements this system imposes on the machine structures and the electro-hydraulic servo systems are carefully outlined. Particular attention is focused on the various figures of merit associated with the machine servo system and the philosophy used in combining the array of components which comprise the complete machine drive. The effects of stiffness, backlash, feedback take-off, and volume of oil under compression on smoothness, steady state errors and transient errors and in turn, the accuracy and finish of the cut are considered.

Herbert Fuldner

Justin P. Wright

• A HYDRAULIC SERVODRIVE FOR A NUMERICALLY-CONTROLLED POSITIONING SYSTEM

by Justin P. Wright, Project Engineer, Jones & Lamson Machine Co.

Positioning by numerical control imposes three basic requirements upon the design of the output driv-

ing device. First, some means for amplifying the low power level electrical signals is needed in order to provide for rapid positioning of heavy outputs such as machine tool slides and carriages. Secondly, the speed of response of the drive system must be high in order to minimize positioning time. And finally, the driving device must be able to position the output to close dimensional tolerances. This paper describes a hydraulic servo drive which meets these basic requirements. This drive is presently being used on a numerically controlled point-to-point positioning system in which the signals from the numerical control circuit drive a three-way valve, differential-cylinder, hydraulic servo.

MOBILE EQUIPMENT

• HYDRAULICS ON THE FOUR-IN-ONE LOADER

by Edward Drott, President, and Philip Pueschner, Project Engineer, Drott Manufacturing Corp.

The Four-in-One is a materials handling tool that is mounted on both crawler and wheel-type front end loaders. It derives its name from the four basic functions that it performs: namely, bucket, bulldozer, scraper and clamshell operation. This paper covers the changes required in the conventional loader hydraulic circuit to adapt it to the requirements of the Four-in-One loader. The addition of an extra valve circuit made the clamshell operation smoother and easier to perform, while modifying the three-spool control valve by adding three relief valves reduced the possibility of structural damage due to improper operation. Formed tubing and swivel fittings to replace lengthy hoses totalled up to a compact, more serviceable hydraulic system.

• HYDRAULIC APPLICATIONS IN MODERN FIRE APPARATUS

by William B. Pashkow, Ass't. to Vice President, Administration, Mack Trucks, Inc.

A general review of hydraulic systems employed in fire fighting vehicles covering the National Board of Fire Underwriter's requirements. The basic pumps, controls, priming units, booster pumps and their characteristic performances. Common and new systems of foam-making now in use as on-board-vehicle equipment for structural and crash fire control.

SERVOMECHANISMS AND SYSTEMS

• APPLICATION OF AN ELECTRO-HYDRAULIC SERVO-VALVE TO AUXILIARY POWER SUPPLY REGULATION

by Murray Goldman and Marvin R. Gore, Aerojet-General Corp.

Auxiliary power supply units, consisting of a single-stage, impulse turbine driving an alternator and a hy-

Continued on next page

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SUMMARIES OF NCIH PAPERS

draulic pump, are important components of missile systems, supplying electrical and hydraulic power for guidance and control. Regulation of frequency is generally required because of the nature of use of the instruments supplied by the alternator. Such regulation can be effected only by a feedback control system which prevents wide variations in speed or large steady-state errors due to hydraulic pump load fluctuations. Specifications for control system design are given in terms of a steady-state and transient envelope about the required frequency. In the system discussed in this paper, turbine power, hence speed, is controlled by a gas by-pass valve positioned by a hydraulic actuator. In order to obtain satisfactory response, an electro-hydraulic servo-valve is used. Alternator frequency is sensed and compared to a fixed reference. The resulting error signal operates the servo-valve which drives the hydraulic actuator.

Murray Goldman

Robert K. Sedgwick

• THE HYDRAULIC SERVO AND TAPE CONTROLLED MACHINE TOOLS

by Robert K. Sedgwick, Assistant Chief Engineer, Kearney & Trecker Corp.

Tape-controlled machine tools depend on weak signals from magnetic, photo-electric or mechanical reading of tapes. These signals must be connected by a long chain of amplifications and switchings to large forces available at the machine slides. The electro-hydraulic servo system offers the best overall performance now available in this field. Use of the electro-hydraulic principle requires all relevant parts of the machine tool to be considered parts of the servo system, with the result that almost every part must be investigated with respect to its mass, spring rate, and the position of its center of gravity. The foundation, also, becomes of great importance, since a stable platform is essential to stable functioning of the servo system. Machines utilizing the electro-hydraulic principle are able to operate over enormous speed ranges without the need for shifting gears. This enables the designer to provide an extreme degree of stiffness in the driven mechanism, with resulting properties that at least approach the innate high-fidelity capacities of the electronic part of the system. ▼▼▼

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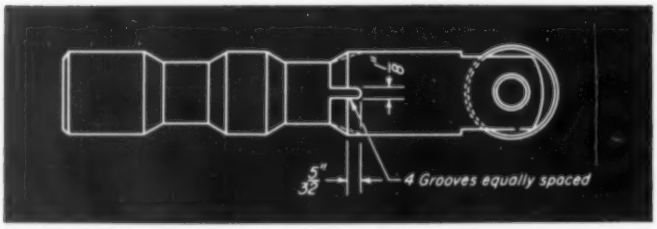
CIRCLE 121 ON TIME-SAVER CARD

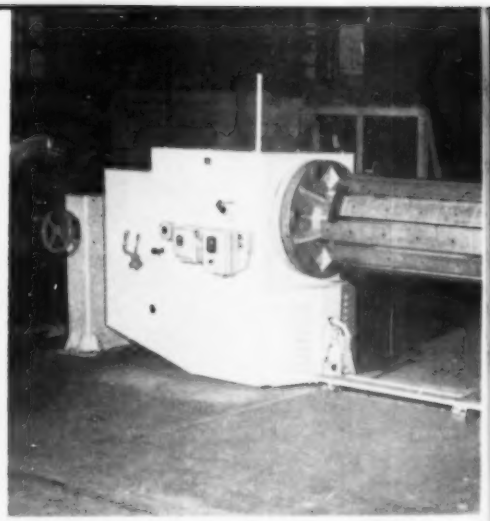
1 WINDING BIG TRANSFORMER COILS such as this one shown coming off the mandrel calls for smooth acceleration and deceleration The operator must also be able to control winding speed precisely.

Hydrostatic transmission controls coil winder

• By H. G. Diamond, *Superintendent of Maintenance, Allis-Chalmers Mfg. Co. Pittsburgh Works, Pittsburgh, Pa.*

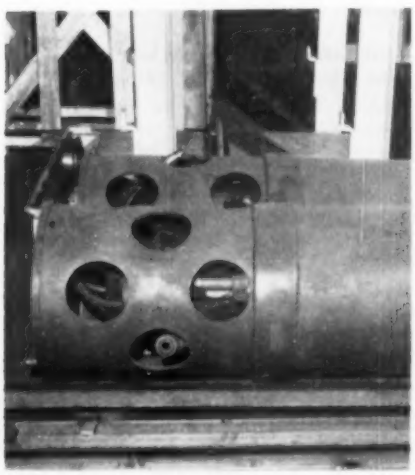


4 ACCELERATION AND DECELERATION are precisely and easily controlled by this modified valve spool. Four grooves, ground in, improve oil metering.

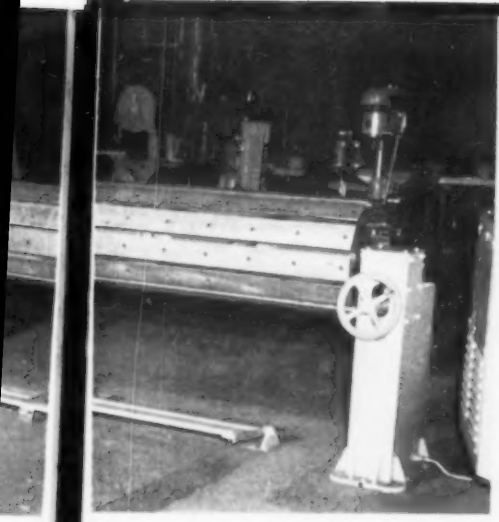


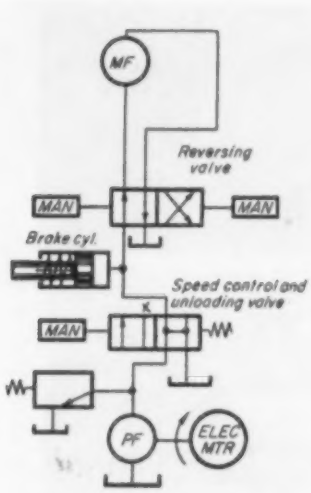
2 . . . Nobody made a machine that filled the bill, so we made this one, and many others like it in various sizes. We experimented with all kinds of drives, including mechanical and electrical. The drive that really did the job turned out to be a simple hydraulic drive.

3 HYDRAULIC CIRCUIT DIAGRAM shows how simple the drive is. A fixed-displacement, 10-gpm pump drives a fixed-displacement fluid motor at speeds to 2000 rpm. Motor torque at 1000 psi is 350 in-lb. A modified, 4-way valve controls speed. A foot treadle coupled by a cam to the valve plunger lets the operator use both hands to guide the wire onto the coil form. When he takes his foot off the treadle, the pump unloads, and a spring-loaded brake stops the mandrel. The brake is released when the operator steps on the treadle, because pressure is applied to the hydraulic cylinder. Although winding is always in one direction, a 2-position, 4-way valve is included in the circuit to reverse the motor and mandrel if necessary.



5 PUMPING UNIT is built into a casing which also serves as the tank and mounting pedestal for one end of the





machine. Casing is installed in the floor. Pump, electric drive motor and relief valve are in the upper end of the casing.

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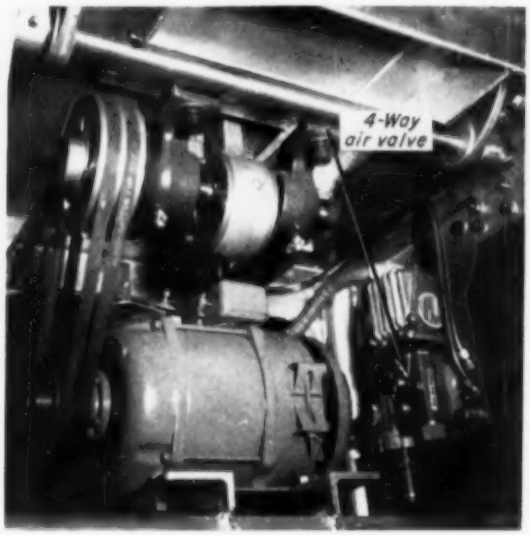
CIRCLE 37 ON TIME-SAVER CARD

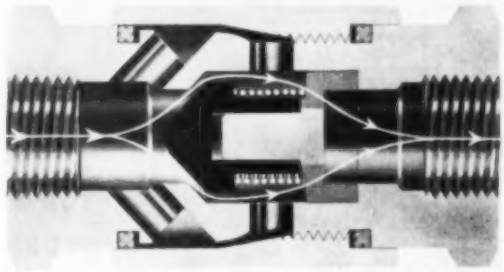
PACKAGING MACHINE processes pressurized cans of all sizes. Shaker is belt-driven by an electric motor through an eccentric shown below. At right below is the 4-way valve which controls four air cylinders.



Flow controls time air cylinders

• By Fred Suellentrop, *President, LeMay Machine Co., St. Louis, Mo.*

and A. R. Baxter *A. R. Baxter Co., St. Louis, Mo.*



Courtesy Hanna Engineering Works

METERED FLOW THROUGH FLOW CONTROL VALVE is adjusted by rotating outer sleeve. Return air unseats the poppet and flows through an orifice equal to the full line area.

ONE 4-way valve controls four cylinders on a machine that packs whipped cream, chocolate syrup, bug killer, and other products in pressurized cans. Rather than load their machine with complicated valving, designers at LeMay Machine in St. Louis found they could time cylinder action by using adjustable flow control valves in the cylinder lines.

The machine pressurizes 11 cans at a time, and shakes them if this is required to mix the gas with the contents. The cans are conveyed to the gas filling station on a belt conveyor. When they are in position, a limit switch energizes the spring-offset, solenoid valve connecting air to the cylinders. A 1-inch cylinder pulls down the conveyor guide, so that a 1½-inch cylinder can then push the cans under the filler head. Another 1-inch cylinder extends to insure that the shaking mechanism is not on dead center where it could not be started.

The gas-filled head is then clamped on the cans by an air cylinder acting through a linkage. The cans are shaken and filled for a period set on an electronic timer. At the end of the timed period, the gas-filling head is released and all cylinders retracted to begin a new cycle.

The adjustable flow control valves are graduated in 1/100ths of a revolution on the adjustment sleeve. Each graduation represents 1/100th of the full line area. The poppet type valves permit free return flow through an orifice equal to the pipe area. They are made of aluminum except for stainless steel springs and synthetic rubber seals and poppets.

▼▼▼

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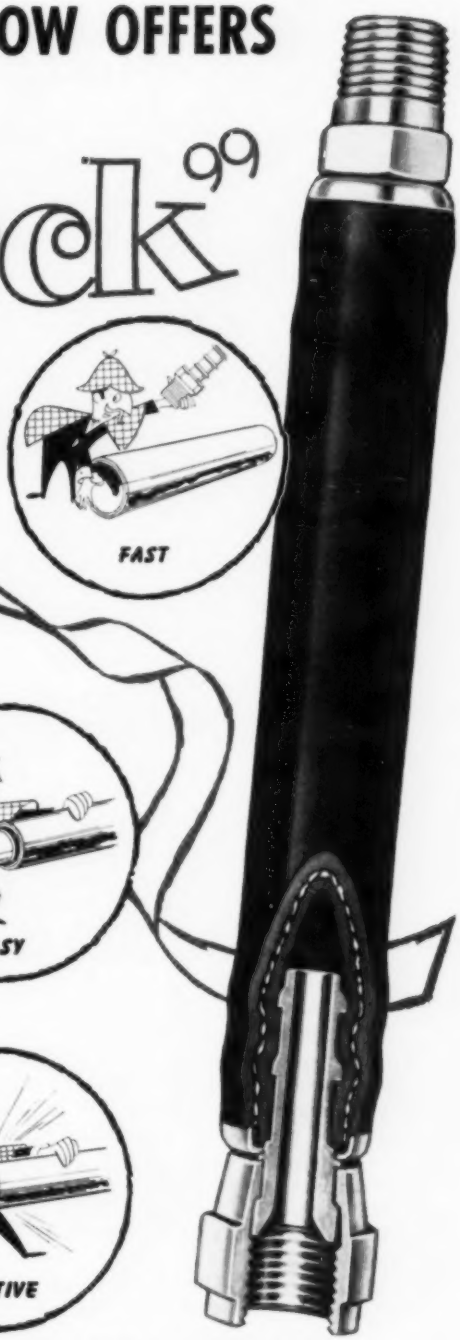

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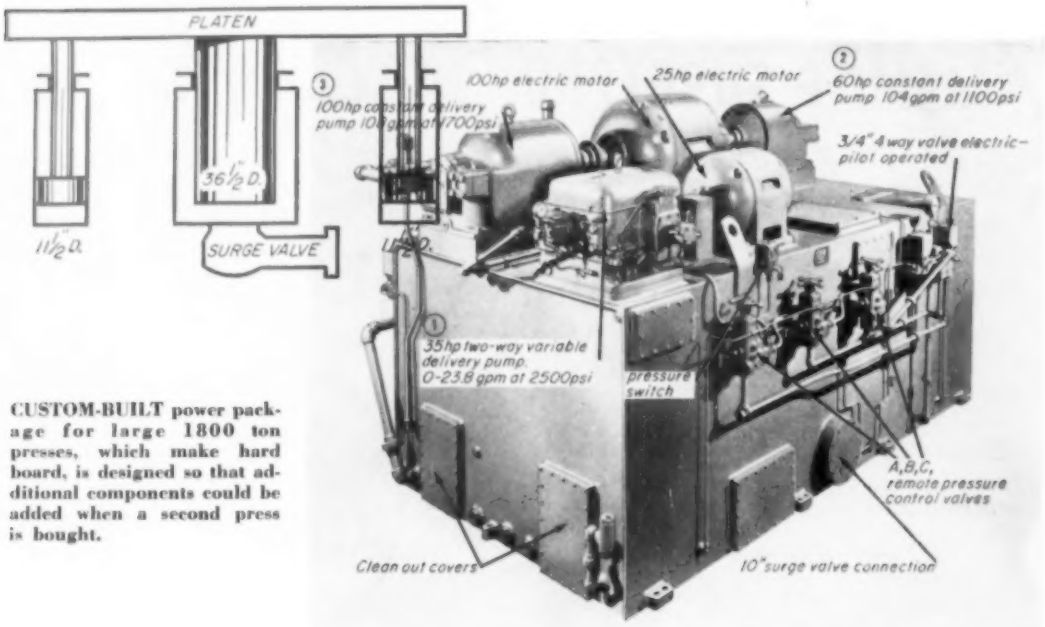
CIRCLE 9 ON TIME-SAVER CARD



CUSTOM-BUILT power package for large 1800 ton presses, which make hard board, is designed so that additional components could be added when a second press is bought.

Courtesy The Oilgear Co.

Packaged hydraulics can be flexible

PACKAGED power units are being used more than ever. Presses are just one application where packages simplify the machine construction; permit tailored cycles, eliminate much maintenance, and offer unusual flexibility when changes in equipment are desired.

Take the power package shown in the photo as an example of how the press builder and user benefit from having all hydraulic power and control components on the reservoir.

• **Components**—The reservoir base, with a 2250 gallon capacity, powers a hard board press. The base, fully equipped, weighs 19,880 lbs. It has seven cleanout covers and two inspection covers. An air breather on the base has a capacity of 550 cipm. The high pressure pipes and fittings have welded joints.

• **Operation**—The push-up type press, with a dead weight of 120,000 lbs closes at speeds up to 244 ipm by delivery of pumps 1, 2 and 3 to the jack rams. When the line pressure reaches 1300 psi, a pressure switch energizes a solenoid on a four-way valve, bypassing pump 2. The press continues to close at speeds up to 137 ipm by delivery of pumps 1 and 3 to the jack rams. At 2000 psi, the surge valve closes and pressure in the cylinders equalizes. Pump 2 is momentarily brought back into the system and the press closes at speeds up to 41 ipm on pumps 1, 2 and 3.

At 1300 psi line pressure, pump 2 will again be bypassed and the press will continue closing at speeds up to 22.4 ipm on pumps 1 and 3. At 2000 psi line pressure, pump 3 will be bypassed and press will close at speeds up to 4.34 ipm on pump 1 until maximum desired pressure is reached (up to 2800 psi). Pump 1 holds the set pressure by remote pressure control valve *A* (250-2800 psi). A timer cuts it out, and the pressure drops to the setting of remote pressure control valve *C* (180-480 psi). Another timer cuts it out, and pump 1 holds the pressure to the setting of remote pressure control valve *B* (250-2800 psi). Pump 1 has an automatic pressure unloading control to reduce the power input and pump to slip stroke when holding the static load.

After remote pressure control valve *B* is timed out, decompression of the press will begin through pump 1 and then through an electrically operated 2-½ in. two-way valve and a 1 in. orifice until 60 psi line pressure is reached. At this line pressure, the surge valve opens. Press moves downward at a rate governed by jack ram discharge through the 1-in. orifice. Timers and pressure switches can be varied to suit other process cycles.

For dual presses a 35-hp two-way variable delivery pump, three remote pressure control valves, timers and pressure switches are added to this package. ▼▼▼

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CIRCLE 93 ON TIME-SAVER CARD

Here's a tricky circuit for an air operated, automatic marking machine that varies marking pressure from 15 to 100 psi.

Tandem cylinders give two pressure ranges

• By H. Clinton Noble, *Noble and Westbrook Mfg., Co., Hartford, Conn.*
and Walter H. Blackler, *Pneumatic Engineering Co., Hartford, Conn.*

PRESSURE required for marking products depends on the type of metal being marked and the size of the characters used for the impression. Here's an all pneumatic machine that covers the full range of pressures required.

• **Pressure Selection**—A tandem table cylinder was used to get two marking pressure ranges. The cylinder has bores of 2½ and 4 in. Setting of the table pressure selector valve determines whether air line pressure is directed to the large or small bore.

The machine head is mounted on four posts and is raised and lowered by manually operating a 4-way valve which controls the head elevation cylinder.

The table cylinder is anchored to the machine frame and the piston rod is attached to the table lifting lever.

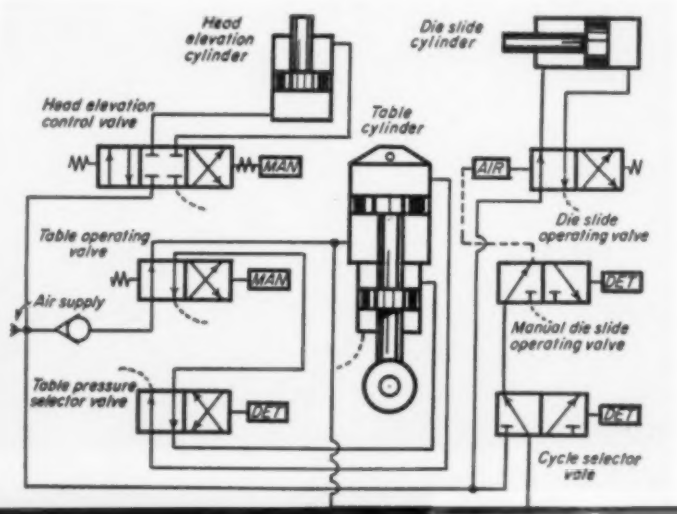
• **Automatic Operation**—When the foot pedal of the table operating valve is depressed, air pressure raises the table cylinder bringing the work in contact with the marking die. The discharge pressure from the chamber below the large piston is high enough to prevent the die slide operating valve from shifting until the table cylinder is fully extended. Then the valve shifts and the die slide cylinder extends, marking the work. The foot pedal is then released directing air to the bottom of the large piston on the table cylinder, and also to the die slide valve actuator. This lowers the table and retracts the die slide cylinder.

• **Manual Operation**—For independent control of table and die slide, cycle selector valve is shifted so that air line pressure is directed to the manual die slide operating valve. The die slide can then be controlled by the manual valve, and the table cylinder with the foot valve. This type of manual operation is needed for setup.

• **Design Considerations**—A standard 1-in air actuator was first tried on the die slide operating valve. It shifted the valve at 45 psi, which prevented using lower marking pressures required for aluminum and other soft metals. An actuator was made using a short stroke, 2¼-in. bore cylinder mounted on the valve. With this arrangement the valve does not shift until the pressure in the cylinder drops to 15 psi.

If a longer delay between full extension of table and die slide operation is needed, a flow control valve can be installed in the line to the cylinder actuating the die slide valve. ▼▼▼

PNEUMATIC CIRCUIT showing the tandem cylinder which gives two pressure ranges, one for marking hard material and the other soft.



DIE SLIDE valve is a standard two-position, 4-way pilot operated valve modified by replacing pilot section with a 2¼-in. bore, short stroke cylinder. Valve won't shift till pressure on the pilot piston falls below 15 psi.

(Above) Red-hot steel slabs, weighing over 2 tons each, are at arm's length from hydraulic lines filled with Irus Fluid 902—YET NO FIRE HAZARD.

(Right) The distinctive yellow color of Irus Fluid makes it easy to spot and trace hydraulic line leaks.

"After numerous tests, we selected Shell Irus Fluid 902 because of its excellent fire resistance and low cost,"

says Norman Bracht, Lubrication Engineer, Alan Wood Steel Company, Conshohocken, Pa.

A fire in the strip mill, causing serious equipment damage and plant down time, convinced the Alan Wood Steel Company that a switchover to a fire-resistant hydraulic fluid was imperative. After extensive testing with various commercial types, Shell Irus Fluid 902 was selected. Now . . . twelve months later . . . Alan Wood is convinced that serious hydraulic fires in strip mill tilt table are a thing of the past.

Irus* Fluid 902 is a specially compounded water-in-oil emulsion which has exceptional fire resistance. Plant tests show, time after time, that Irus Fluid 902 *actually snuffs out fire!*

Many plant operators, like Alan Wood Steel, have discovered that Irus Fluid is economical . . . costing up to one-third less than other fire-resistant fluids, yet its performance is comparable in every practical respect.

If your present hydraulic equipment is vulnerable to accidental fire hazard, we suggest that you obtain complete technical information on Shell Irus Fluid 902. Write: Shell Oil Company, 50 West 50th Street, New York 20, N.Y. or 100 Bush Street, San Francisco 6, California.

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SHELL IRUS FLUID 902

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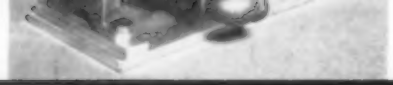
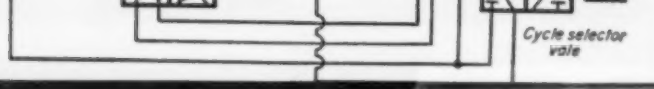
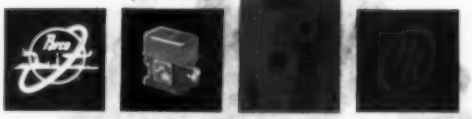
CIRCLE 112 ON TIME-SAVER CARD





O X O

Hydraulic Research and Manufacturing Company pioneered the first electro-hydraulic servo valve to combine precision hydraulic design and operation, with dependable dry coil construction, without sacrificing performance.



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OCTOBER 1958

AVIATION SECTION

HYDRAULIC TURBOPUMP 114

By M. C. Toth

Lightweight, small-size power package includes pump, drive turbine, reservoir, and all controls to maintain system pressure between 2800 and 3000 psi. Maximum delivery of 8 gpm is gotten with only 37-lb package.

SYNCHRONIZING WING FLAP CYLINDERS 116

By E. C. Fox

Hydraulically-operated flaps can't be easily synchronized mechanically on a mid-wing jet. This mechanical-hydraulic system, proved in service on Short Bros. & Harland's S. B. 5, is effective and reliable.

AVIATION NEWS FROM THE FLUID POWER FIELD 120

AVIATION COMPONENT DATA 122

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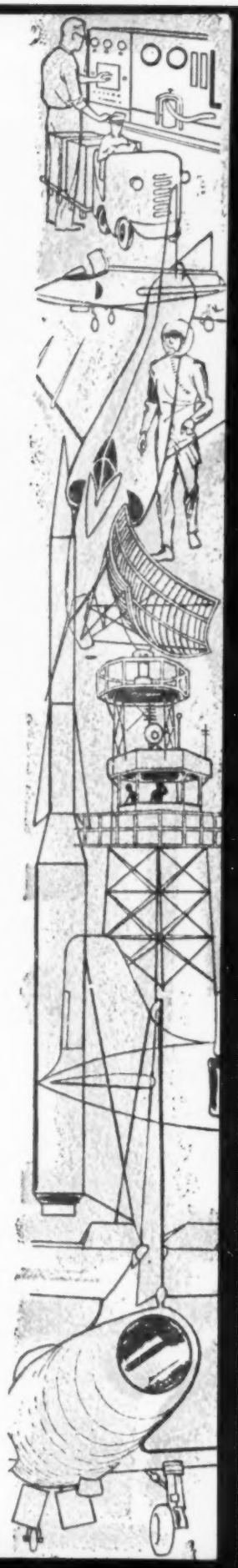
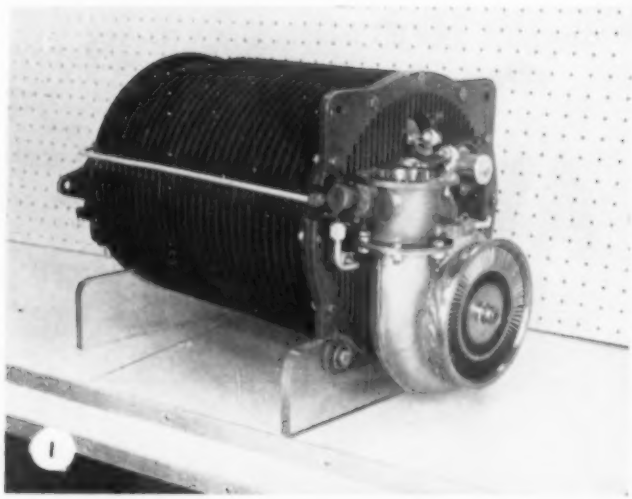


CIRCLE 97

Lightweight and small size are what every aircraft designer dreams about. Here's a complete hydraulic power package that fills the bill.



Hydraulic turbopump ...power in a small package

• By M. C. Toth, *Senior Application Engineer, Aircraft Accessory Turbine Dept., General Electric Co., Lynn, Mass.*

PUMP, reservoir, oil heater, oil cooling system, filters, drive turbine, speed controls, and pressure controls—you get them all in a newly developed hydraulic power package, Figure 1. It weighs 37 lb and will deliver 8 gpm of MIL-0-5606 at 3000 psi. It will also operate with Skydrol. Reliability and life are increased by intermittent operation. This power pack runs only when system pressure drops to 2800 psi. When there is no demand for oil, the turbine shuts down.

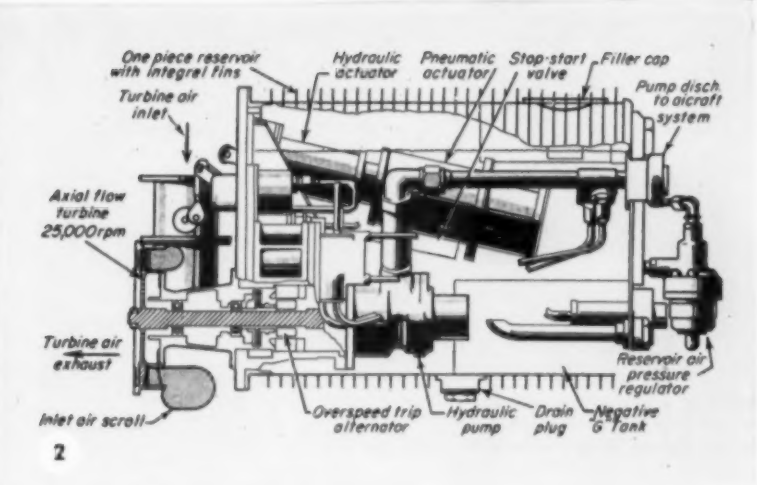
• **Operation**—Ram air or air bled from a jet engine compressor is used to drive the turbine. A butterfly valve in the turbine inlet pipe throttles the air to control turbine speed. Maximum turbine speed is 25,000 rpm. The turbine drives either a ball piston pump or a gear pump. The ball piston pump runs at 25,000 rpm. A speed reducer is used with the gear pump to limit maximum speed to 8000 rpm.

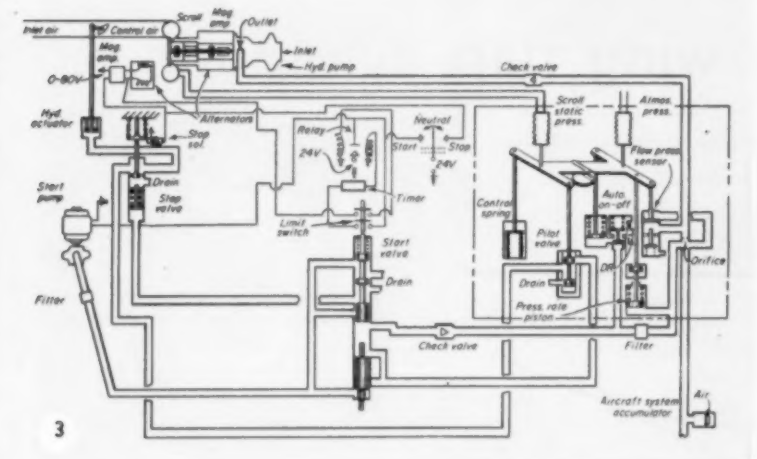
The pump, whether piston or gear, is mounted in the oil reservoir below the fluid level, Figure 2. Pump output is then fed to the aircraft system. The reservoir is magnesium and holds 1200 cu. in. of fluid. Integral fins provide enough cooling for intermittent operation. Since the tank is all one piece, there is little chance of leaks.

• **Control**—Turbine speed is regulated by a hydraulic system that positions the butterfly valve so that flow will be enough to maintain the regulated pressure. For flow rates above 2 gpm, the turbine runs continuously. For flow rates lower than 2 gpm, the unit cycles on and off.

Figure 3 is a schematic of the system. To start, push a switch in the cockpit. This starts an electrically-driven START pump. Its pressure moves the STOP valve to the position shown on the diagram to block the drain and apply pressure to the actuator. Pressure from the START pump is supplied to the actuator through the START valve and PILOT valve, to open the butterfly and start the turbine. When pressure in the turbine-pump outlet line comes up to normal, a pressure switch stops the START pump.

Pressure from the turbine-pump is applied to the system and also to the controls. The control which modulates air to the turbine by controlling the actuator is the PILOT valve. Its position is established by a group of controls, all mechanically connected to the





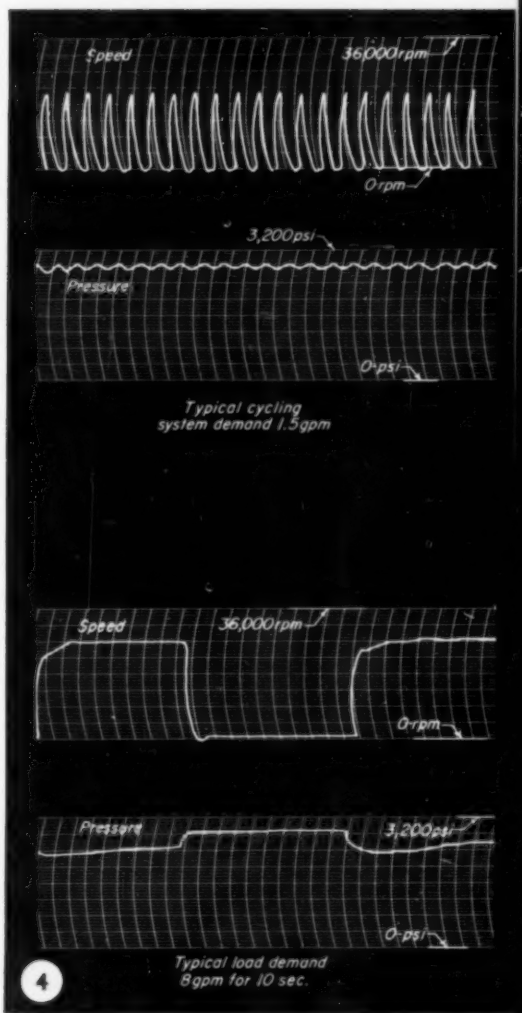


FIG. 1. THIS 37-LB. TURBINE-DRIVEN hydraulic power package will supply 8 gpm of MIL-0-5606 at 3000 psi. The unit includes all necessary speed and pressure controls.

FIG. 2. CROSS-SECTION through the turbine-pump hydraulic power package.

FIG. 3. SCHEMATIC DIAGRAM of the turbine-pump power package. Pilot valve and its controls are within the dashed line.

FIG. 4. OSCILLOGRAPH TRACES of turbine speed and hydraulic pressure for different flow demands.

PILOT valve as shown in Figure 3. Atmospheric pressure, static pressure in the turbine scroll, hydraulic pressure, pressure due to flow, and rate of pressure rise are all balanced against each other to control PILOT valve opening.

The AUTOMATIC ON-OFF valve ports pressure to tank at 3000 psi and lets the spring in the actuator close the butterfly to stop the turbine and pumps. This valve closes when pressure drops to 2800 psi to start the system up again. The FLOW PRESSURE SENSOR, whose output is proportional to pressure drop across an orifice and, therefore flow rate will cause the PILOT valve to dump pressure to drain if flow rate requirement exceeds system capacity. This would mean exceeding turbine speed. An emergency overspeed control consists of an alternator on the turbine shaft, a magnetic amplifer and a solenoid that unlatches the STOP valve to port hydraulic pressure to drain.

● **Turbine Design**—The turbine wheel weighs only 9 oz and moment of inertia is 1.2 lb-in.^{2} Acceleration varies from 400,000 to 800,000 rpm per sec. This gives very fast response to an increase in system demand. Tiny titanium buckets are fastened to a thin steel disc by pins so the pins will shear and the buckets will be shed if all other speed controls fail. This happens at from 60,000 to 65,000 rpm. Discharge section of the turbine is designed to contain the buckets and prevent damage if this happens. Tests have shown that this works. ▼▼▼

FIG. 1. THE EXPERIMENTAL S. B. 5 AIRPLANE was built to study aerodynamic behavior of swept-wing airplanes at and near the stall speed. Location of the wing and the jet engine made it impossible to mechanically connect the wing flaps.

Hydraulic cylinders must often be synchronized. Here's the way Short Bros. & Harland did it on their S. B. 5 airplane. In use for several years now, the system has proved effective and reliable.

Synchronizing wing flap cylinders

• By E. C. Fox, *Systems Engineer, Short Bros. & Harland Ltd., Belfast, Ireland*

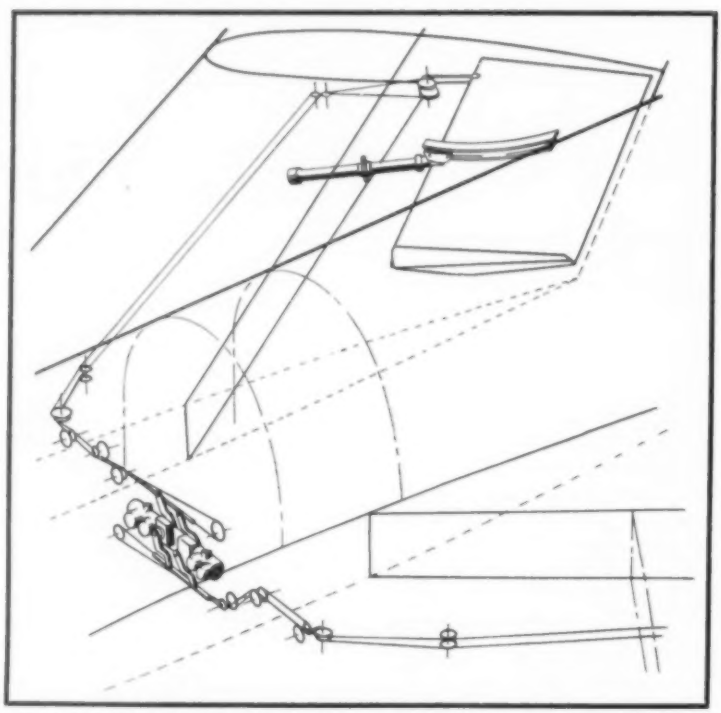


FIG. 2. CABLES CONNECTED TO THE WING FLAPS run to a mechanical linkage that moves the synchronizing valves when flaps are out of step. System is light because it does not have to handle high force.

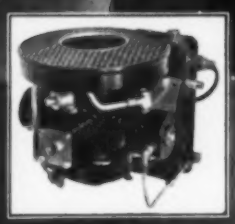
AN AIRCRAFT'S wing flaps must extend and retract together. Differences in both lift and drag caused by one flap being extended more than the other would make the ship hard to control. The most efficient and simplest way to synchronize the flaps is to tie them together mechanically. But, on a midwing jet plane like Short's S. B. 5, Figure 1, there's a jet engine in the way.

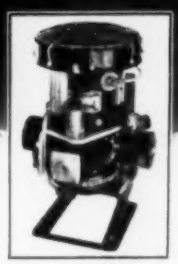
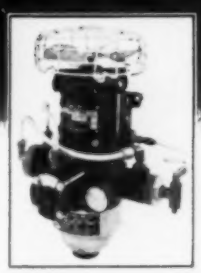
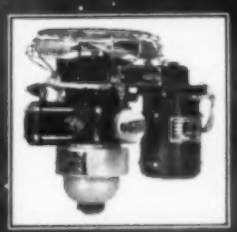
With the flaps operated by hydraulic cylinders, synchronization might be possible using flow dividers or flow-control valves. These, however, still leave room for improvement. By combining mechanical and hydraulic methods we positively synchronized the two cylinders even though they are quite a distance apart.

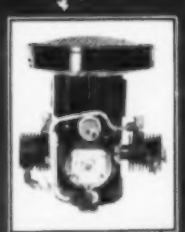
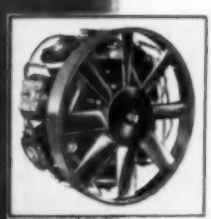
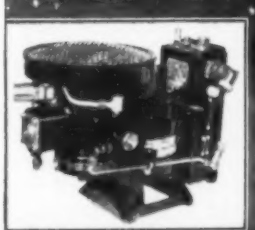
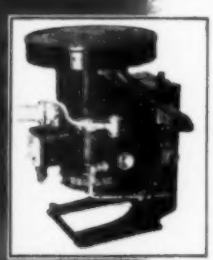
• **How It's Done**—A flap on each wing is extended or retracted by a separate hydraulic cylinder. A light, simple cable system, Figure 2, connects each flap to a pair of synchronizing valves. These valves are between the flap con-

Cornelius

world's most popular airborne compressors...



It's no mere coincidence that Cornelius has manufactured more airborne compressors than all other makes combined – in fact, of all aircraft carrying compressors, 98% use Cornelius.

Engineers who specify them tell us the reason is clear: *Cornelius compressors have what it takes – efficiency-wise and performance-wise.* Model for model, they are the smallest, lightest and coolest running of any made. Cornelius compressors give you a choice of hydraulic, AC, DC, or engine drive. Some models weigh only 9 pounds *complete with motor.* They will deliver from 0.5 to 10 SCFM at pressures up to 3000 PSI, through a full range of altitudes and temperatures. 5000 PSI models are also available for special applications.

For complete information consult a Cornelius catalog or discuss your requirements with a Cornelius Sales Engineer. He has the experience and information that will save you time and money.

THE Cornelius COMPANY

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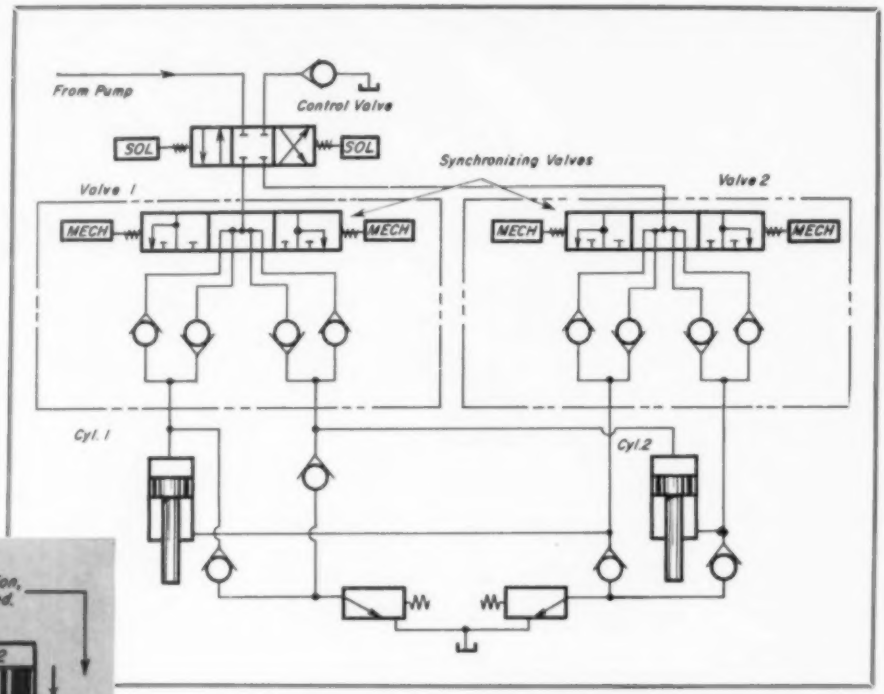
*Photographs show but 10 of the 36 different Cornelius compressors available.

Cornelius

WHEN IT COMES TO COMPRESSORS . . . THERE IS NO SUBSTITUTE FOR EXPERIENCE

CIRCLE 36 ON TIME-SAVER CARD



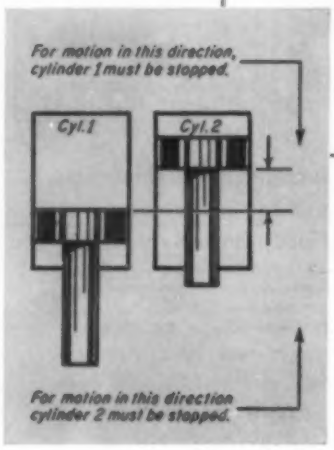

For motion in this direction, cylinder 1 must be stopped.
Cyl. 1
Cyl. 2
For motion in this direction cylinder 2 must be stopped.

FIG. 3. HYDRAULIC CIRCUIT DIAGRAM shows how the synchronizing valves work. Four check valves are built into each synchronizing valve. They are necessary to make the system work for both directions of cylinder travel. This is because the synchronizing valves shift the same way for either direction when the pistons are displaced in the same manner, see sketch. For example, when the rods are extending, and rod 1 is ahead of 2, fluid must be blocked from cyl. 1 until 2 catches up. On the return stroke, the same relationship between the pistons, and the same valve shift will occur when piston 2 is ahead of piston 1. But, the fluid must then go to cylinder 1 while flow is blocked to cylinder 2.

The relief valves in the circuit, which are connected through check valves to both ends of the cylinders keep overloads from any cause from damaging the system.

trol valve and the hydraulic cylinders in the circuit, Figure 3.

The spool-type synchronizing valves are connected to the cable system so that the valves remain centered and have no effect on flow to or from the cylinders as long as the flaps move together. But, if one flap should get ahead of the other, the cable system and linkage will shift the valves to throttle flow both in and out of the cylinder that is moving too fast, Figure 4. Flow at both ends of the cylinder must be throttled because the air load on the flap tends to extend the cylinder during part of the stroke. When the slow cylinder catches up, the synchronizing valves are centered by the cables and links. ▼▼▼

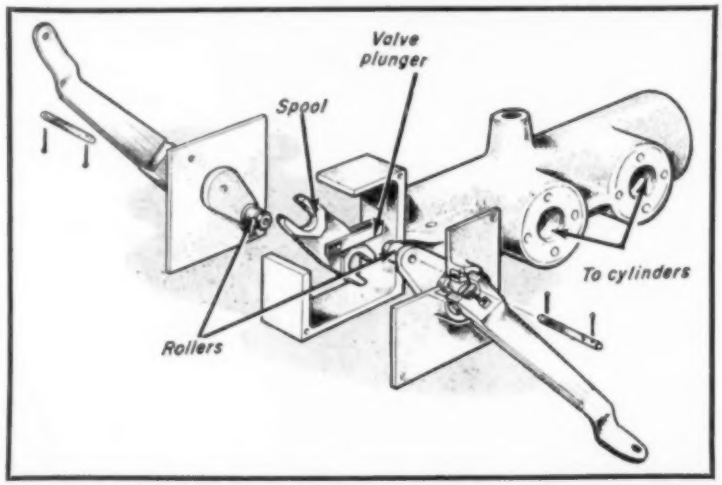


FIG. 4. EACH SYNCHRONIZING VALVE is operated by two cranks driven by the cable system. If both cranks turn at the same speed (flaps synchronized), the spool connected to the valve plunger rotates but does not move the valve plunger. If the cranks move at different speeds (flaps not synchronized), the valve plunger moves to throttle flow to and from the fast cylinder.

CIRCLE 131 ⟶

Victor Regulators control high pressure gases...safely and accurately

GD700 SERIES for testing pneumatic components or operating gas systems. Gas-O-Dome primary regulator is controlled by a relief venting, high pressure, spring loaded regulator. This combination offers you precise regulation for both low or high volume applications.

MODEL	PSI MAX. INLET	PSI OUTLET RANGE	GAUGES (integral or panel mounting)
GD710	7000	400-7000	10,000-10,000
GD711	7000	200-3600	10,000- 5,000
GD712	7000	200-2000	10,000- 4,000
GD713	7000	50- 800	10,000- 1,000
GD714	7000	10- 150	10,000- 200
GD700	3600	200-3600	5,000- 5,000
GD701	3600	200-2000	5,000- 4,000
GD702	3600	50- 800	5,000- 1,000
GD703	3600	10- 150	5,000- 200

Flow: Approx. 300 scfm. Leakage: None.
Operating temp. range: −67° F to +200° F (Storage −80° F)

LR SERIES Loading Regulators for "dead end" and low capacity testing (2 sfcm.) of pneumatic components, or for operating gas systems. Will hold dead-end pressures without leakage—also will hold supply pressure even when inlet pressure decreases.

MODEL	PSI MAX. INLET	PSI OUTLET RANGE
LR20B	7000	40-7000
LR19B	7000	20-3600
LR18B	7000	15-2000
LR17B	7000	10- 800
LR16B	7000	5- 200

Operating Temp. Range: −67° F to +200° F (Storage −80° F)
Leakage: None.

BOTH GD700 AND LR SERIES are field proved. They regulate all non-corrosive gases, including oxygen. Forged bronze bodies; stainless steel trim; Kel-F seats; internal filters; built-in adjustable relief. Proof pressure 2 times rated pressure; burst pressure 3 times rated pressure. Panel mounting. Stainless steel models available for corrosive gases. For complete specifications, write us today.

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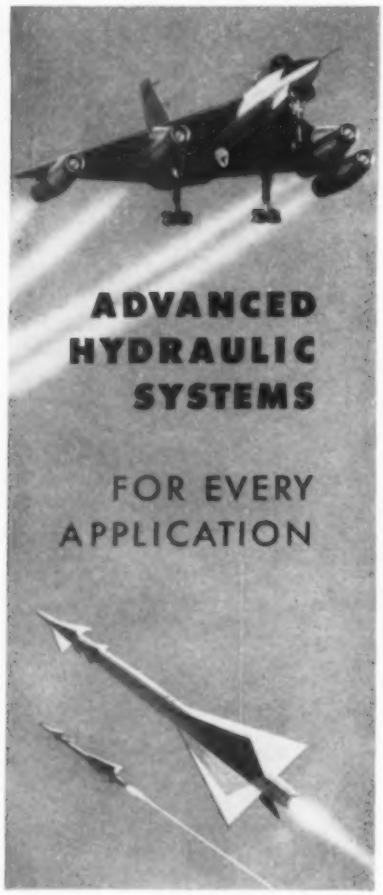

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ENGINEERING OPPORTUNITIES AVAILABLE

CIRCLE 22 ON TIME-SAVER CARD

AVIATION NEWS

from the fluid power field

The Cornelius Co., Minneapolis, Minn. has announced consolidation of the company's aircraft and portable compressor sales. The new department will be called the **Aero Division** of The Cornelius Company. **Joseph W. Mahanay** has been appointed sales manager of the division. He had formerly been manager of aircraft equipment sales for Cornelius.

J. W. Mahanay
Cornelius Co.

Aero-Test Equipment Co., Inc. is now located in larger facilities at 1601 Dragon St., Dallas, Texas.

The Air Force has awarded the **Georgia Division of Lockheed Aircraft Corp.** a contract to study power operated hydraulic and pneumatic systems to be used in space vehicles. Designs will be established by determining the requirements peculiar to space craft.

C. H. Cannon, Lockheed staff engineer in charge of mechanical systems engineering, will be directly in charge of this program for the Air Force.

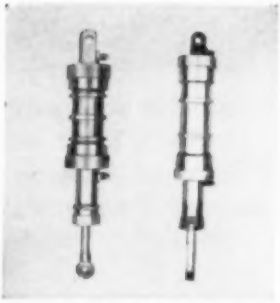
Admiral Selden B. Spangler, USN retired is now director of research for the **Garrett Corp.,** Los Angeles, manufacturer of aircraft and missile components. Known as the father of the Navy's gas turbine program, Admiral Spangler is given a large share of credit for development of the propeller gas turbine in the United States.

George L. Nankervis Co., Detroit, Mich., has published a 4-page bulletin describing their missile test and support equipment. It gives complete details on Model 9440 hydraulic test cart used to simulate missile power packages for production checkout.

HYDRAULIC BRAKES . . .

. . . ease the Titan missile into a vertical position on this static test stand at Denver, Colo. The test facility is operated by The Martin Co. Missile is lifted from vertical to horizontal by a 150 hp winch. At 14 degrees before vertical the hydraulic braking system takes over. The winch continues to lift the erector against 1500 psi hydraulic pressure in four 8-in. cylinders. This braking gives smooth seating of the erector in vertical position and acts as a safety brake to counterbalance changing center of gravity and wind loads.

Braking for lowering the missile is done by varying the dynamic load on the electric motor and by a winch brake fail-safe system. Both systems are actuated by a 150-psi nitrogen system which is also used for remote control of high pressure valves, fuel, and liquid oxygen.



PNEUMATIC ACTUATORS: High pressure, for use in hot gas servo systems or in afterburner nozzle area control and thrust reverser controls.

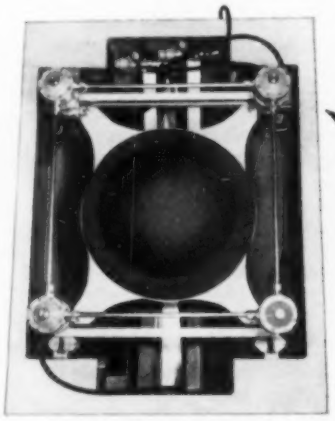
PRESSURE SWITCH: Controls cut-in and cut-out compressor pressures. Hermetically sealed, accurately maintains system pressure and serves as system pressure indicator.

CONTROL VALVE: 5000 psi, manual. Controls air flow to actuating components from supply source. Can be actuated directly by hand, cable pull, or other manual means.

METAL STORAGE CYLINDERS: 5000 psi—have moisture drain fittings which also provide connecting port between the cylinder and the rest of the pneumatic system.

FROM THE BLAZING INFERNO
OF AN AFTERBURNER
TO THE TORTUROUS VIBRATION
OF A MISSILE...

KIDDE COMPONENTS SOLVE YOUR PNEUMATICS PROBLEMS!



Vibration Isolation System

Vibration Isolator

Newest Kidde development: The Pneumatic Vibration Isolation System. Employing relatively inexpensive components, it maintains desired low natural frequency and reduces the relative displacement at various load conditions.

The system shown above is one of several Kidde pneumatic vibration isolation system programs for protecting delicate missile control systems from undesirable vibratory disturbances and great transients in "g" loading which would affect accuracy of control. The component in the inset photo incorporates the system's mechanical and air snubbers, air spring, servo valve and passive isolator.

Research on projects like this new vibration isolation system goes on constantly in Kidde's vast creative pneumatics engineering department. For more information on any Kidde components, or help in solving specific pneumatics problems, write or call Kidde today.

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CIRCLE 76 ON TIME-SAVER CARD

SOLENOID VALVE: New one-half inch pilot-operated valve. Extremely fast response time (25 milliseconds) for use in systems involving pulsating, high pressure gases.

QUICK DISCONNECT: Double-check – permits fast coupling or uncoupling of components without pressure loss. Has pressure check in both inlet and outlet unit.

FIBERGLASS SPHERES: Non-shatterable, 5000 psi. Feature very high strength-to-weight ratio. High impact resistance, excellent chemical immunity.

PORTABLE GROUND SERVICE CART: 4cfm compressor, drive unit, air driers and pneumatic storage sphere. Provide service at either 3000 or 5000 psi.

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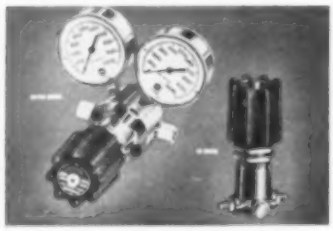
Pressure Regulators
. . . for 7000 psi

For air and gases. The GD700 for testing pneumatic components in missiles and aircraft, and for operating gas systems. Maximum flow rate 300 scfm. The LR series



are for dead end and low capacity testing (2 scfm). Will hold supply pressure once it is established even when inlet pressure decreases. Both have spring ranges to 7000 psi and temperature range —67 to 200 F.—*Victor Equipment Co., San Francisco, Calif.*

CIRCLE 500 ON TIME-SAVER CARD

Hydraulic Reservoir
. . . is lightweight

Fabricated from .081-in. 6061-T-6 alloy aluminum. All welded construction and qualified and tested to MIL-R-5520A, including slosh, vibration and 150 psi burst test. Diameter 10¼ in., height 15½ in., weight 10-¾ lbs. Liquid capacity 800 cu in. Equipped with integral filter, MS pressure release, thermocouple bulb, liquid level sight gage, and a two-inch release filler cap with pressure vent and filler screen.—*All American Engr. Co., Wilmington, Del.*

CIRCLE 501 ON TIME-SAVER CARD

Test Cart
. . . for missile hydraulics

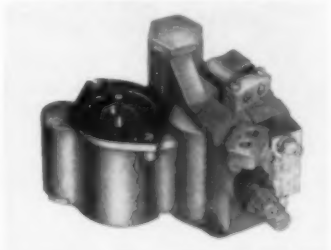
Cart simulates the hydraulic power package used in the missile. It delivers 10 gpm of oil at pressures to 3000 psi and keeps back pressure on the system to ±1 psi.

Used while systems are in production the cart is powered by a 15-hp electric motor. It will also flush the system. Two ten-micron filters are used. Model 9440 is being used on the Army's Jupiter missile.—*George L. Nankervis Co., Detroit, Mich.*

CIRCLE 502 ON TIME-SAVER CARD

Auxiliary Power Pack
. . . runs at 12,000 rpm

Known at model E/HS 110, Type 200 the unit will deliver 0.6 gpm at 2000 psi of MIL-O-5606 oil with an efficiency over 70%. It has a reservoir of 10 cu in. and a

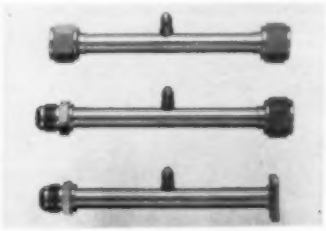


compensating bellows to adjust for thermal expansion. The built-in filter has a spring-loaded bypass. A check valve is provided for ground checkout of the hydraulic circuit without using the auxiliary power unit.—*Eastern Industries Inc., Hamden, Conn.*

CIRCLE 503 ON TIME-SAVER CARD

Measuring Sections
. . . for pressure and temperature

Stainless steel tubing with smooth inside finish and close tolerance on eccentricity. From ¼ to 2 in. tube with working pressure to 5000 psi. Made of straight sections conforming to ASME power



test code and aviation industry standards. Male or female AN tube connectors or flanged ends. Pressure takeoff and thermocouple probe connectors available.—*Kahn and Co., Hartford, Conn.*

CIRCLE 504 ON TIME-SAVER CARD

Continued on page 124

CIRCLE 45 ⟶

USE ONE OF THESE TIME-SAVER CARDS...

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New Products

Descriptions start on page 52

PUMP AND MOTOR 300
Tuthill Pump Co.

AIR BLEED-OFF VALVE 301
Denison Engineering Div.

HYDRAULIC CYLINDERS 302
Carter Controls, Inc.

CHECK VALVES 303
Kepner Products Co.

ELECTRIC MOTOR ADAPTER 304
General Electric Co.

AIR MUFFLER 305
Allied Witan Co.

HYDRAULIC PUMPS 306
Webster Electric Co.

PILOT CHECK VALVE 307
Regent Jack Manufacturing Co.

HOSE TEST STAND 308
Aeroquip Corp.

MOISTURE SEPARATOR 309
Wilkerson Corp.

NEEDLE VALVES 310
Hoke Inc.

GAGE GUARD 311
Industrial Engineering Corp.

AIR LINE LUBRICATOR 312
Watts Regulator Co.

AIR CYLINDER 313
Worcester Valve Co.

THROTTLING VALVE 314
Shaffer Tool Works.

BALL VALVE 315
Hydromatics Inc.

HYDRAULIC WHEEL 316
Mechanisms Inc.

POWER PACK 318
Brown & Sharpe Mfg. Co.

HYDRAULIC CYLINDERS 319
Benton Harbor Engr. Wks.

AIR LINE CONTROLS 320
A. Schrader's Son

AIR CYLINDERS 321
Airmatic Valve Co.

GAGE SNUBBER 322
Chemiquip Co.

ELECTRIC MOTOR 323
Reliance Electric and Engr. Co.

RELIEF VALVE ACTUATOR 324
United Hydraulics Inc.

HYDRAULIC CHECK 325
Burklyn Co.

RETAINER RINGS 326
Bearings Inc.

PRESSURE SWITCH 327
Square D Co.

BELLOWS 328
The Hydrodyne Corp.

Useful Literature

Descriptions start on page 62

HYDRAULIC CYLINDERS 400
Hanna Engineering Works

OIL FILTERS 401
The Hilliard Corp.

OCTOBER, 1958

Circle number to receive free information about any product described or advertised in this issue.

ADVERTISERS

1	21	41	61	81	101	121	141	161	181	201	221
2	22	42	62	82	102	122	142	162	182	202	222
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6	26	46	66	86	106	126	146	166	186	206	226
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10	30	50	70	90	110	130	150	170	190	210	230
11	31	51	71	91	111	131	151	171	191	211	231
12	32	52	72	92	112	132	152	172	192	212	232
13	33	53	73	93	113	133	153	173	193	213	233
14	34	54	74	94	114	134	154	174	194	214	234
15	35	55	75	95	115	135	155	175	195	215	235
16	36	56	76	96	116	136	156	176	196	216	236
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18	38	58	78	98	118	138	158	178	198	218	238
19	39	59	79	99	119	139	159	179	199	219	239
20	40	60	80	100	120	140	160	180	200	220	240

NAME

POSITION:

COMPANY:

PRODUCT MFG.:

STREET

CITY ZONE STATE

Do not use after 1-15-59

NEW PRODUCTS

300	305	310	315	320	325	330	335
301	306	311	316	321	326	331	336
302	307	312	317	322	327	332	337
303	308	313	318	323	328	333	338
304	309	314	319	324	329	334	339

FREE LITERATURE

400	405	410	415	420	425	430	435
401	406	411	416	421	426	431	436
402	407	412	417	422	427	432	437
403	408	413	418	423	428	433	438
404	409	414	419	424	429	434	439

AVIATION DATA

500	505	510	515	520	525	530	535
501	506	511	516	521	526	531	536
502	507	512	517	522	527	532	537
503	508	513	518	523	528	533	538
504	509	514	519	524	529	534	539

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11	31	51	71	91	111	131	151	171	191	211	231
12	32	52	72	92	112	132	152	172	192	212	232
13	33	53	73	93	113	133	153	173	193	213	233
14	34	54	74	94	114	134	154	174	194	214	234
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No postage stamp necessary if mailed in the United States

BUSINESS REPLY MAIL — First Class Permit No. 8066, Cleveland, O.

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USE ONE OF THESE TIME-SAVER CARDS...

...for more information on advertised products, new components, useful literature, etc. Just circle item number and drop in the mail.

AIR FILTERS — 402
Hankison Corp.

HYDRAULIC TRANSMISSIONS — 403
Louis deRoll Ironworks Ltd.

FILLER CAPS — 404
Gabb Special Products, Inc.

VARIABLE DISPLACEMENT PUMPS — 405
The Oilgear Co.

TEST PLUGS — 406
Mechanical Products Co.

HOSE FITTING ADAPTERS — 407
Parker-Hannifin Corp.

SOLENOID VALVES — 408
Atkomatic Valve Co., Inc.

TIME DELAY RELAYS — 409
Tempo Instrument Inc.

CYLINDER TUBING — 410
Tube Reducing Corp.

FLOW REGULATORS — 411
Waterman Engineering Co.

DIGITAL INDICATORS — 412
Performance Measurements Co.

STRAIGHT-THREAD FITTINGS — 413
Flodar Corp.

THERMAL RELIEF VALVE — 414
Fluid Regulators Corp.

AIR LINE CONTROLS — 415
Wilkerson Corp.

FIRE-RESISTANT FLUIDS — 416
E. F. Houghton & Co.

MARINE FLUID POWER — 417
The Oilgear Co.

SILICONE FLUIDS — 418
Dow Corning Corp.

PRESSURE REDUCING VALVES — 419
Jordan Corp.

FOUR-WAY VALVES — 420
Sarasota Precision Products Co.

Aviation Component Data

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PRESSURE REGULATORS — 500
Victor Equipment Co.

HYDRAULIC RESERVOIR — 501
All American Engr. Co.

TEST CART — 502
George L. Nankervis Co.

AUXILIARY POWER PACK — 503
Eastern Industries Inc.

MEASURING SECTIONS — 504
Kahn and Co.

ELECTRIC MOTORS — 505
The Hoover Electric Co.

PRESSURE TRANSDUCER — 506
Dynamic Instrument Co.

HYDRAULIC MOTOR — 507
Lear Romec Div.

SOLENOID 3-WAY VALVE — 508
Robertshaw-Fulton Controls

MINIATURE PRESSURE SWITCH — 509
Alloy Bellows Co.

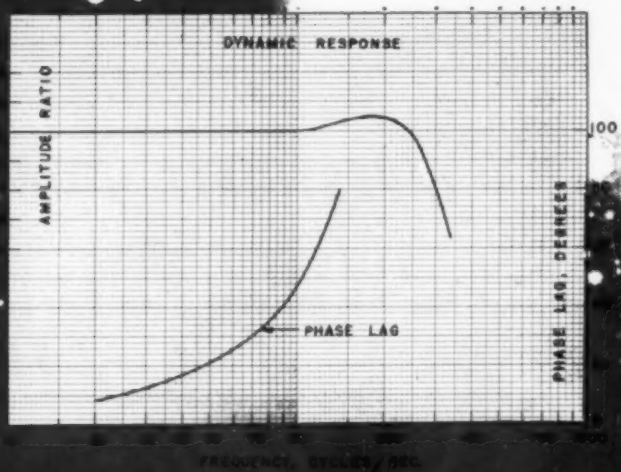
VALVE-SHUTTLE — 510
M. C. Mfg. Co.

VIBRATION ISOLATOR — 511
Walter Kidde & Co.

FILTER ELEMENTS — 512
Bendix Filter Div.

HYDRAULIC MOTOR — 513
New York Air Brake Co.

NEW METHOD OF SERVO CONTROL



reliable, high performance at low cost

Eastern's Time-Modulated Servovalve utilizes the principles of pulse-length modulation. Type E SV-105-200R is a solenoid-driven, single-stage electrohydraulic valve that completely eliminates *hysteresis and threshold* effects.

Other major advantages of this PLM type valves are:

- High performance with 40 micron filtration.
- High frequency response.
- Elimination of hydraulic pre-amplifier yields higher hydraulic efficiency and reduces cost.
- Small signal sticking is eliminated.
- The electric transducer may be optimized for out-put force rather than linearity, resulting in economy of size and weight.

For full technical information on Eastern Servovalves, write for new Bulletin SV10.

Eastern AVIATION PRODUCTS

EASTERN INDUSTRIES, INC.

100 SKIFF STREET • HAMDEN, CONNECTICUT

West Coast Branch office: 1608 Centinela Ave., Inglewood 3, Calif.

CIRCLE 1 ON TIME-SAVER CARD

Fall ... *the original*

SPRING-LOADED

Wiper **Ring**

This patented closed joint ring provides squeeze-grip action, assuring complete contact on the rod at all times. Maintains uniform, continuous pressure on wiper edge. Rods are always clean in any temperatures.

Fall "CJ" Wiper Rings operate most effectively under extreme conditions of dust, glaze, oil, grit, powder, gases, sand, ice, etc. Available in diameters ½" through 13". For any commercial use. Used by military and aviation industry since 1944.

ACE PRODUCTS CO.

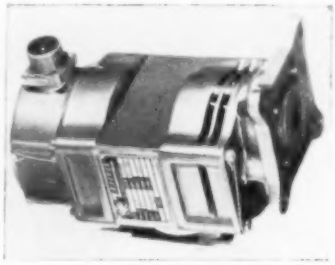
1820 N. 12th St. Toledo 1, Ohio

Est. 1935

AVIATION COMPONENT DATA

Electric Motor
... for 28v dc operation

Applications include hydraulic pump, air compressor, and fuel pump drives. Will develop 2 hp at 3000 rpm. Open frame construction with integral cooling fan. Rectangular laminations give high power density. Patented brush holder gives even pressure over full

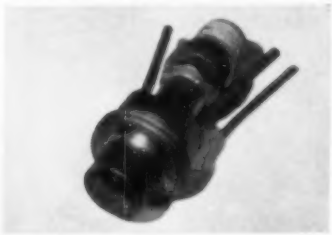


wear range and reduces arcing. Foot or end mounting. Keyed or splined output shaft. —*The Hoover Electric Co., Columbus, Ohio.*

CIRCLE 505 ON TIME-SAVER CARD

Pressure Transducer
... is water cooled

The strain-gage type pressure pickup has a flush-mounted pressure diaphragm with a double-spiral



cooling passage. Pressure range to 2000 psi with overload protection to 4000 psi. Excitation, 30v ac or dc. Full scale output 1.5 mv/v. All stainless steel construction. Coolant water pressure, 35 psi.—*Dynamic Instrument Co., Cambridge, Mass.*

CIRCLE 506 ON TIME-SAVER CARD

Hydraulic Motor
... drives fuel booster pump

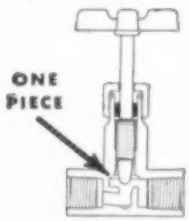
Unit consists of a centrifugal pump driven by a stationary block type hydraulic motor. With a tank pressure of 25 psia it pumps 106,000 pph of JP-5 fuel at 33 psig

MARSH *Needle Valves*

MAXIMUM WORKING PRESSURE 10,000 PSI

... for finer regulation of water, oil or gas

First needle valve to combine all the characteristics called for in modern industry. Embodies sturdiest basic construction—machined from solid bar stock—suitable for pressures to 10,000 psi and equally efficient in lower range. Note stem guide fused to body by new "Conoweld" process, eliminating faults of conventional two-piece valves. Stem 416 stainless steel. Stem threads fine pitch for strength and micrometer regulation. Body electro-zinc plated. Sizes ⅛" to 1", globe and angle patterns.



Ask for new Needle Valve Catalog

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corp.* Dpt. 19, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd Street, Edmonton, Alberta, Canada

CIRCLE 84 ON TIME-SAVER CARD

INVESTIGATE MARK-TIME

MECHANICAL TIMERS FOR O. E. M. USES

NEW **FREE** CATALOG

ELIMINATE ELECTRICAL FAILURES

Custom-built timers in small, medium or large quantities are our specialty. Over 3,000 **different** kinds of timers presently being produced. Timers can be designed to ring bells, flash lights, turn valves, cut cords, stop, start or operate electrical or mechanical equipment, etc. Timing ranges from seconds to hours. Unlimited uses for practically all products — all fields.

SECRET

Current use in guided missile program includes four major areas — TESTING, LAUNCHING, FIRING, RECOVERY. R. & D. work welcome.

M. H. RHODES, INC. HARTFORD CONNECTICUT

CIRCLE 105 ON TIME-SAVER CARD

from sea level to 80,000 ft. The hydraulic motor develops 15 hp at 4400 rpm with a flow of 8.3 gpm and pressure 3000 psi. Fluid operating temperatures —65 to 450 F. Stainless steel construction.—*Lear-Romec Div., Lear Inc., Elyria, Ohio.*

CIRCLE 507 ON TIME-SAVER CARD

Solenoid 3-Way Valve . . . weighs 0.77 lb

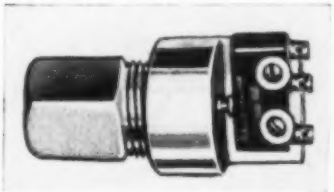
Made for use on aircraft and missiles the valve measures 3.4 x 2.07 x 2.09 in. and will handle 3000 psi. The ¼-in. valve can be used for hydraulic fluids or gases.

It has a new captive seal floating between the poppet and seat. A steel retainer encircles the O-ring to prevent expansion and provide a mechanical stop for poppet and valve seat.—*Robertshaw-Fulton Controls Co., Bridgeport Thermostat Div., Milford, Conn.*

CIRCLE 508 ON TIME-SAVER CARD

Miniature Pressure Switch . . . weighs only 1 ounce

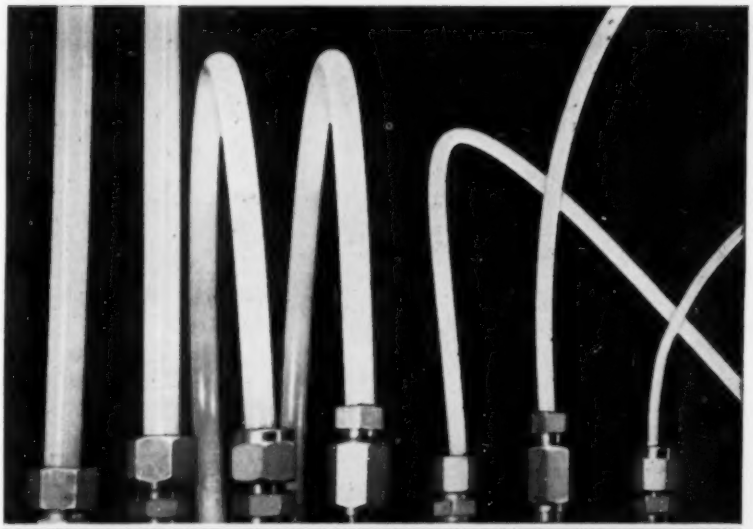
Will operate from 25 to 1000 psi with an over-pressure rating of



3000 psi. Actuating pressure is factory-set. Made of aluminum, it is a piston-type switch with only one moving part. Switch rating 5 amps at 240 v, single-pole double-throw will operate in any position and has ⅛ in. NPT inlet port.—*Alloy Bellows Inc., Cleveland, Ohio.*

CIRCLE 509 ON TIME-SAVER CARD

Continued on next page



Use Chemiseal® NYLON PRESSURE TUBING

ECONOMICAL	Outperforms metal at a fraction of the cost. Saves installation labor.
FLEXIBLE	Saves flexible couplings, and intermediate fittings.
DURABLE	Exceptionally high resistance to flex and vibrational fatigue. Resists abrasion and impact.
STRONG	Types for 1000 psi and 2500 psi.
ADAPTABLE	Sizes from ⅛" to ½" O.D. —useable with any standard metallic flare or compression fittings.
SERVICEABLE	At temperatures ranging from —100°F to +225°F. Unaffected by hydraulic fluids, oils, alkalies, most solvents.

For prompt service, contact one of The Garlock Packing Company's 30 sales offices and warehouses throughout the U.S. and Canada, or write for further information.

United States Gasket Company
Camden 1, New Jersey

United States Gasket

Plastics Division of GARLOCK

CIRCLE 129 ON TIME-SAVER CARD

CIRCLE 110 ON TIME-SAVER CARD

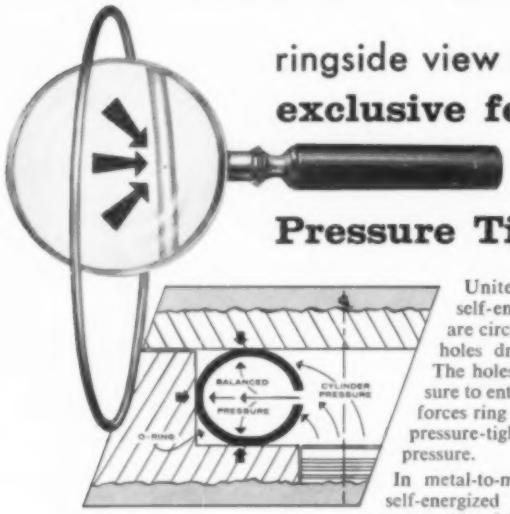
WHICH SEAL WILL SOLVE YOUR PROBLEM?

Seals drawn to same scale.				
Type of Seal	**Standard**	**Modified**	**Bellows**	**Shaft Surface**
Pressure (PSI)	1000	500	250	75
Speed (FPM)	15,000	15,000	15,000	15,000
Temperature (°F)	350° to 450°	—360° to 350°	—360° to 700°	500° to 700°
Uses	Fluids including aviation fuel, synthetic lubricants, etc.	Rocket motors, HNO_3, H_2O_2, NPN, LOX, Ethylene Oxide	Applications calling for all-metal, high temperature sealing	Sealing gaseous mediums in a minimum amount of axial space
Send for	Bull. #7	Specially engineered	Bull. #18	Bull. #19

CAUTION: Maximum conditions indicated for each type do not necessarily imply that all are available in a single seal. Sealol engineers will gladly recommend the seal best suited to the operating conditions of your particular application. Write today . . . no obligation, of course!

SEALOL CORP
1510 Post Rd., Providence 5, R.I.

SEALOL



ringside view of United's **exclusive feature** for

Pressure Tight Seals

United's exclusive, patented* self-energized metallic O-rings are circular tubes vented by tiny holes drilled in the ring wall. The holes allow contained pressure to enter the ring which then forces ring wall to form positive pressure-tight seals under high pressure.

In metal-to-metal applications, self-energized metallic O-rings are capable of forming positive, permanent, non-corrosive static seals under extreme temperatures from —321°F. to 1800°F., and under pressures equal to ultimate compression stress of the metal itself. Available in various metals and finishes, 3/8" dia. to any size or configuration. United also makes non-vented and pressure-filled O-rings; and wire and brazing O-rings. Write for free 22-page booklet (on your letterhead please).

PATENTS 2,609,269; *2,837,360

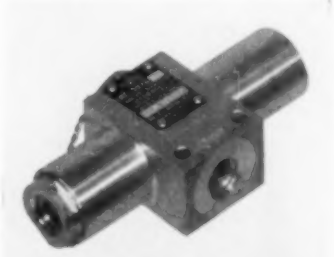
UNITED METALLIC "O" RING CORP.
Dayton, Ohio • Box 1038
Division of United Aircraft Products, Inc.

CIRCLE 127 ON TIME-SAVER CARD

AVIATION COMPONENT DATA

Valve-Shuttle
. . . weighs 0.45 lb.

For use in aircraft Type II hydraulic systems, it meets requirements of MIL-V-19068A. For hydraulic fluid and nitrogen at pressures to 3000 psi and temperatures

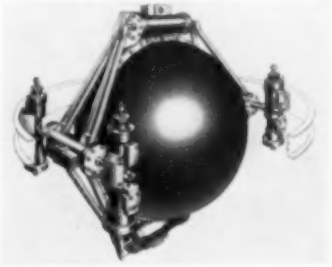


—65 to 275 F. Port connections for ¼-in. tubing. The MC 5070 valve is designed so reverse flow will not unseat poppet. Made for airborne applications it can also be used on ground support equipment.—*M. C. Mfg. Co., Detroit, Mich.*

CIRCLE 510 ON TIME-SAVER CARD

Vibration Isolator
. . . has gas springs

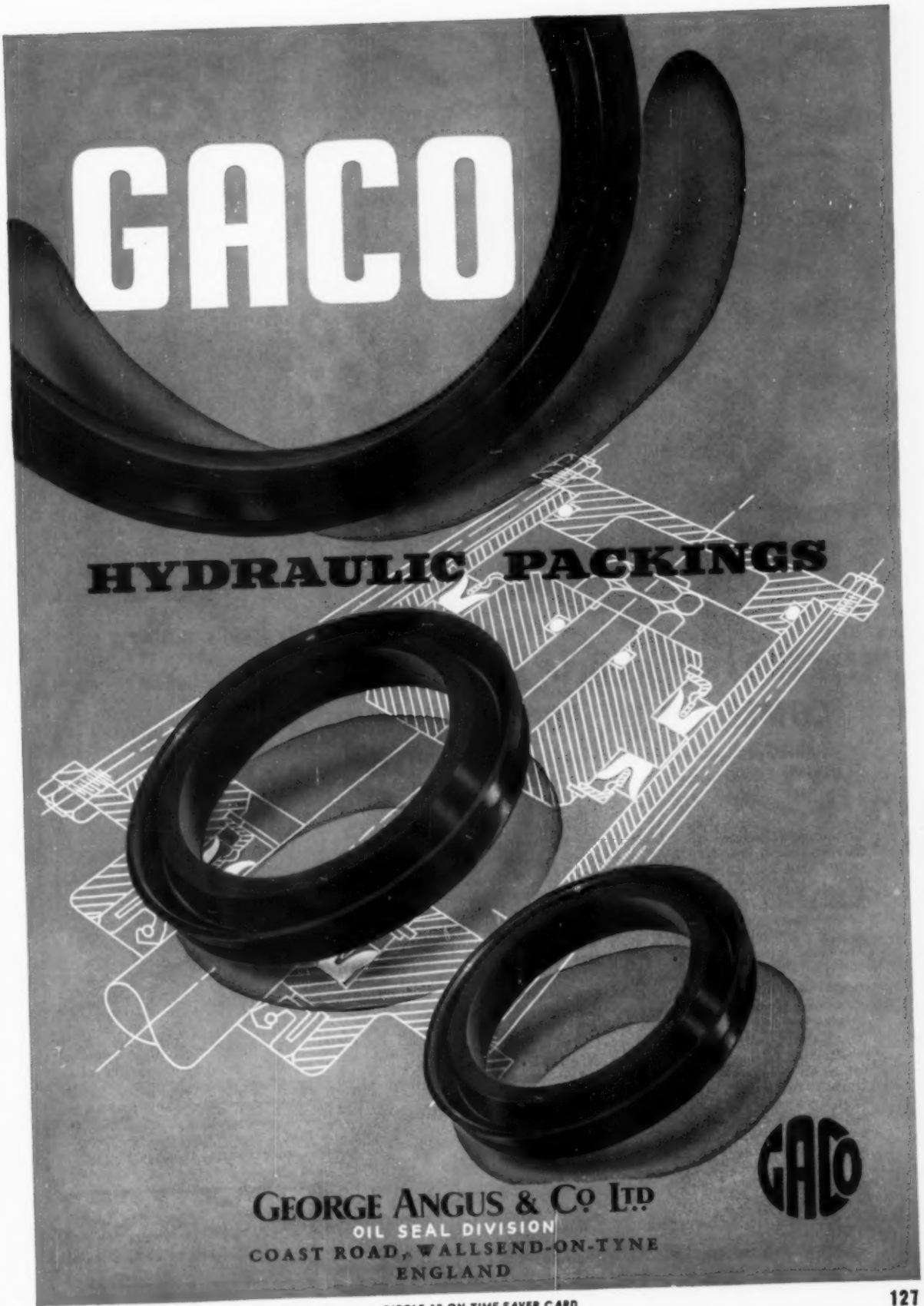
Protects delicate units such as missile controls, aircraft components, and sled test instruments subjected to rapid g load changes. It does this by maintaining a low natural frequency while limiting



relative displacement at various load conditions. The system has three sets of servo-controlled gas springs, each set absorbing vibration and acceleration along one of three perpendicular axes. The unit was made by *Walter Kidde & Co., Inc., Belleville, N. J.*

CIRCLE 511 ON TIME-SAVER CARD

Continued on page 128



CIRCLE 13 ON TIME-SAVER CARD

Another example of SYSTEMS CAPABILITY *at Sanders Associates, Inc.*

ELECTRO-HYDRAULIC CONTROL COMES DOWN TO EARTH!

Feedback principles that control missiles and aircraft in flight now produce uniform road grades regardless of ground variations.

This electro-hydraulic feedback system for controlling heavy earth-moving machinery, developed by Sanders Associates, Inc., is now in the field test stage.

In this application, the blade of a road grading machine is automatically controlled at a pre-set angle regardless of the contour or roughness of the ground over which the grader travels. Leveling accuracy of the system is ⅛ inch in ten feet or 1 milli-radian. The result is faster, simpler grader operation, improved smoothness of road beds, reduced operating costs.

This is another example of how the integrated "systems engineering" approach at Sanders can provide unusual and effective solutions to your control problems in industrial, marine, missile, aircraft, or atomic fields.

Sanders manufactures and supplies all major components of electro-hydraulic control systems; a complete line of servo valves for positioning; rate gyros and accelerometers for sensing; electronic components for amplifying and decision-making. This practical experience in hydraulics, electro-mechanics and electronics can expedite development of new automatic control systems for machine tools, structural testing, materials handling and construction equipment as well as military applications.

Visit our suite at the Hotel Sherman during the NCIH.

SANDERS ASSOCIATES, INC.

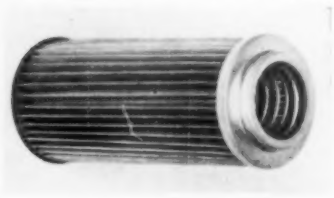
NASHUA, NEW HAMPSHIRE • *Dayton, Ohio • Inglewood, California • Washington, D.C.*

CIRCLE 138 ON TIME-SAVER CARD

AVIATION COMPONENT DATA

Filter Elements
. . . in porous stainless steel

Made to fit any standard aircraft or missile filter housing. Model 62350 elements are made for pres-



sures to 3000 psi and temperatures to 500 F. From 5 to 250 micron particle ratings with flows to 12 gpm. Can be cleaned and reused. *—Bendix Filter Div., Bendix Aviation Corp., Madison Heights, Mich.*

CIRCLE 512 ON TIME-SAVER CARD

Hydraulic Motor
. . . has high efficiency

Rated at 3000 psi the unit weighs 5.75 lb. Stall torque 85% of running torque. Torque efficiency 93%. Overall efficiency 90%. Operating temperature 275 F stand-

ard, 400 F special. Capacity 3.5 gpm at 1500 rpm. Will take continuous speeds to 6400 rpm. Friction losses have been reduced by the hydrostatic balancing of internal parts. *—Watertown Div., New York Air Brake Co., Watertown, N. Y.*

CIRCLE 513 ON TIME-SAVER CARD

For more information on these products use the TIME-SAVER CARDS

CIRCLE 56 ON TIME-SAVER CARD

For long-lived high performance, get

GAST ROTARY AIR PUMPS

Here's the broad Gast Line of Air Compressors. Vacuum Pumps, too, are made in all these models. Capacities from .6 to 45 cfm., pressures to 30 psi., vacuum to 28" Hg. Rotary-vane design is simple, efficient, dependable. Positive, pulseless air delivery—no tank needed. For plant use or O.E.M., *get Gast quality!*

Write for Gast Catalog; describe your specific needs.

GAST MANUFACTURING CORP., P.O. Box 117-D
Benton Harbor, Michigan

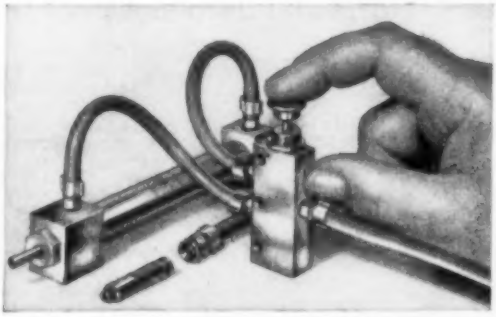
See Catalog in Sweet's Design File

GAST ROTARY

- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

"Air may be your answer!"

NEW! MORE Powerful 9/16" MINIATURE AIR CYLINDERS · 4-WAY AIR VALVES · QUICK CONNECTS



NEW more powerful 9/16" bore spring return and double acting MINIATURE Air Cylinders to complement our widely used 3/8" bore cylinders, NEW 4-way Air Valve, Quick Connects, A.C. and D.C. Solenoids, fittings, mountings and other needed items to improve your automatic tooling and production devices or new end products. Made for MILLIONS of cycles of trouble-free operation! Modestly priced.

Write NOW for NEW Bulletin MA ⟹

Clippard INSTRUMENT LABORATORY, INC.

7372-H Colerain Rd., Cincinnati 39, O. • Phone: JA 1-4261

Manufacturers of R. F. Coils, Electronic Equipment, Miniature Pneumatic Devices

CIRCLE 32 ON TIME-SAVER CARD

NEW AGASTAT®

HAS LONGER OPERATING LIFE

The Agastat time/delay/relay has been completely re-designed, inside and out, to make every moving part last longer and operate more reliably.

The new models measure only 4-9/16 (max.) x 2-9/16 x 2-5/8" and feature flexible contacts that provide a wiping action for more positive contact continuity. Contacts are larger, so heat dissipates faster. The new contact material lasts longer, too.

The over-all timing range of the Dial Head models is from 0.08 seconds to 15 minutes. Five models, each covering a segment of this range, are available. They are color-coded to identify their particular timing range. Any given timing range can be adjusted with just one revolution of the dial. The time intervals remain the same no matter how often you readjust the unit. For extra convenience, the Agastat has wiring diagram and calibration data plate.

Write for details and application engineering assistance to Dept. A31-1030.

AGA DIVISION

Elastic Stop Nut Corporation of America

1027 Newark Avenue, Elizabeth, New Jersey

Pioneers in Pneumatic Timing

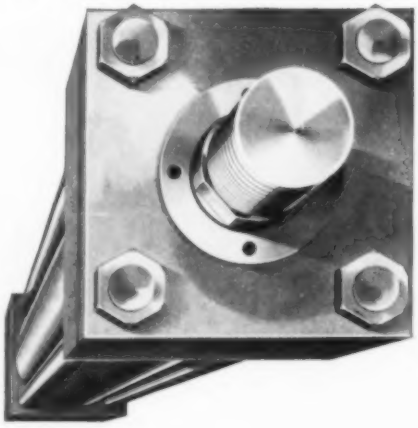
CIRCLE 6 ON TIME-SAVER CARD

CIRCLE 12 ON TIME-SAVER CARD

NEW

Standard Line
Square-Head

HYDRAULIC CYLINDERS



ANKER-HOLTH

- 3000 P.S.I. Non-Shock Pressure
- Interchangeable Mountings
- Bores from 1½" to 12"

WRITE FOR CATALOG

ANKER-HOLTH DIVISION
THE WELLMAN ENGINEERING COMPANY
2723 CONNOR STREET, PORT HURON, MICH., U.S.A.

24 HOUR DELIVERY ON BASIC CYLINDERS

One air

THE mounting holes for chrome trim strips were drilled in the auto bodies and doors before assembly. The strips didn't always line up evenly when the doors were mounted on the body. An auto manufacturer built a fixture to drill all holes after the doors were mounted. With 42 holes to drill in a different pattern on each model, the control could have been complicated, but they avoided it.

• **Valve selection**—Instead of a separate valve to control each one of the 108 drills needed, they decided to run all the drills for each model from one large valve. The valves are fed directly from a large overhead reservoir pipe to give quick and ample air power to the drills. The proper set of drills for a given body is selected by an electric switch that supplies current only to the solenoid

IMPROVED
HYDRONIC
REMOTE CONTROL SYSTEM

- Completely Hydraulic
- Positive, Accurate
- 100% Responsive

FOR CONTROL OF ANY MECHANISM UP TO 100 FEET AWAY

The HYDRONIC System is a distinct advance in the remote control field. It offers all the advantages and simplicity of a self-contained hydraulic system. Backlash, motion inaccuracies and installation difficulties inherent in mechanical linkages or push-pulls are eliminated. The HYDRONIC System is unaffected by wear and vibration.

Master and slave levers maintain perfect synchronization even under wide temperature changes through 114° arc with 500 in. lbs. output in either direction. A simple adjustment permits instant relative positioning of levers.

Write for complete information today.

THE HYDRONIC COMPANY
12685 Arnold-Detroit 39, Mich.

CIRCLE 72 ON TIME-SAVER CARD

New infinitely-variable, multi-range

FLOW CONTROL

in 3 standard sizes

New precision Flow Control solves today's highly particular demands for uniform feed-rate on machine tool applications. Features—infinitely-variable control to permit setting full scale to exact maximum required by the system. Exceptionally sensitive flow selection with safe, simple, fool-proof operation. Eliminates flow change due to temperature-viscosity change. Multi-range control allows one model to meet all flow control requirements. No surge overtravel when hydraulic feeds are engaged. Built-in relief valve saves space. Built-in check valve permits reverse free flow. Requires no external drain. Three standard sizes—¼", ⅜", ½". Built to JIC standards for operating pressures to 2000 psi. Write for details. Bulletin VFC-3. Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

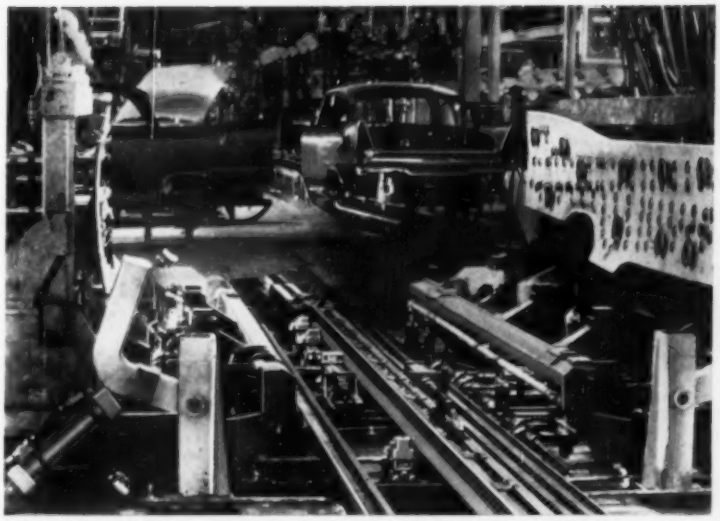
CIRCLE 41 ON TIME-SAVER CARD

valve controls many drills

valves controlling that particular set of drills. Drills are powered by air motors.

• **Operation**—A conveyor moves the body into position. The operator sets the electric switch for the proper group of drills. Locator pins extend to seek out location holes, then lifting cylinders bring the body into position. A limit switch is tripped, and through a solenoid control valve, two cylinders advance and bring forward the panels that carry the banks of drills. Vacuum cups hold the panels during the drilling.

The drills advance, then retract on signal from a timer. When the timer calls for it, the drill panels are unlocked and retracted, the lift cylinders are retracted, and the locking pins withdrawn. The conveyor then moves the body out of the fixture. ▼▼▼



FIXTURE for drilling 42 holes in auto bodies is all air operated.

Information supplied by Ross Operating Valve Co.

KOHLER
PRECISION CONTROLS

Two, three and four way
PLUG VALVES

Hydraulic control valve for machine tool operation, drain cocks for fuel systems, shut-off valve for instrument air line—these are among the Kohler Plug Valves used by leading manufacturers.

Kohler Plug Valves will meet all your lower pressure installation and operating specifications. They have a stainless steel plug, precision lapped into a forged aluminum body. Furnished with two, three or four ports, with or without mounting flanges—and with plugs drilled to your requirements.

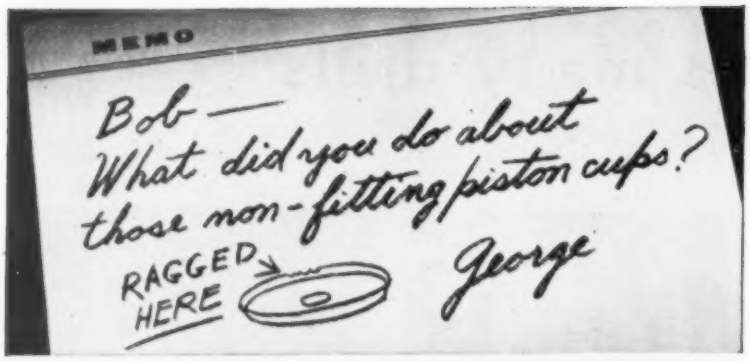
Our engineers develop valves and fittings to specifications for volume production. Write for information.

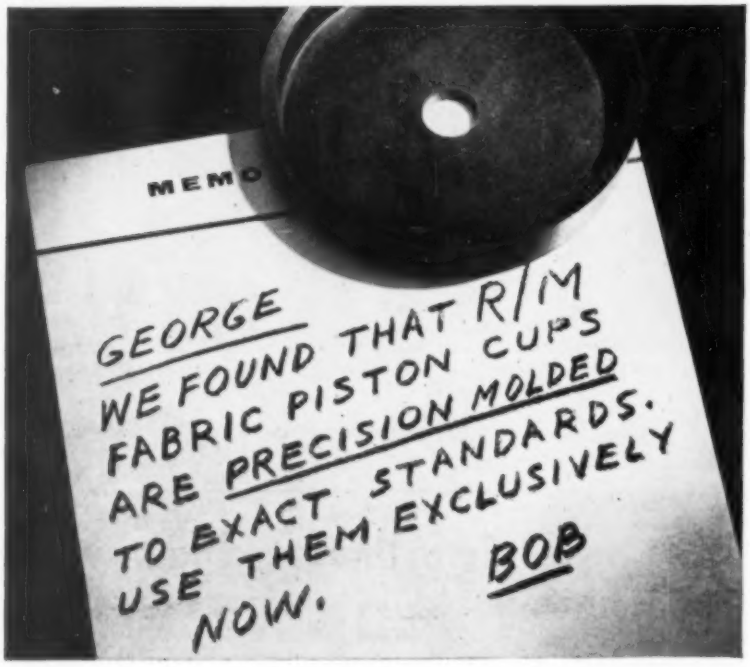
KOHLER CO. Established 1873 KOHLER, WIS.

KOHLER OF KOHLER

Enameled Iron and Vitreous China Plumbing Fixtures • Brass Fittings • Electric Plants • Air-cooled Engines • Precision Controls

CIRCLE 77 ON TIME-SAVER CARD





You can be sure of minimum friction, long life, when you specify R/M Fabric Piston Cups. Molded of engineered synthetics with a variety of fabric reinforcements to suit your requirements. Superior resistance to extrusion.

Careful quality control at Raybestos-Manhattan makes a big difference you can see: clearly defined contours and cleanly trimmed edges. This is proof of dimensional uniformity, strict adherence to industry standard sizes. Your gain: maximum sealing efficiency.

R/M Fabric Piston Cups are made to fit hydraulic and pneumatic cylinders ranging in diameter from ½ to 12 in. Furnished in varying degrees of hardness for pressures up to 1500 psi and in different compounds to meet your specific operating conditions.

R/M's complete line of mechanical packings includes Vee-Flex Packings, Vee-Square Packings, Homogeneous V-rings, and Fabric Piston Cups. Write for complete information.

R/M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

CIRCLE 102 ON TIME-SAVER CARD

NEW PRODUCTS

NEEDLE VALVES
. . . have plastic stem tips

Designation: Series 270

Features: Nylon or corrosion-resistant Kel-F plastic coated stem tip. Over-torquing won't damage seat

or stem. Tested at 700 cycles with 3500 psi and double normal torque —no leakage. Meet military specifications for use on high pressure compressors.

Specifications: For pressures to 5000 psi. Tips available on ⅛ or ¼ in. valves. Teflon packing or O-ring stem seal. Can be panel mounted.

Hoke, Inc.
Englewood, N. J.

CIRCLE 310 ON TIME-SAVER CARD

GAGE GUARD
. . . for low pressures

Designation: GG-1 & GG-2

Features: Made in two models to handle pressures from 20 in. water

to 9000 psi. Unit is repeatable and will reopen after sealing at two percent below the cut-off point. Can be

factory set or have manual adjustment.

Specifications: Size 3¼ x 1½ x 1¾ in. Weight 11 oz. Made in aluminum or stainless steel. Has ⅜ in. NPT inlet port and ⅛ in. NPT outlet ports.

Industrial Engineering Corp.
Louisville, Ky.

CIRCLE 311 ON TIME-SAVER CARD

AIR LINE LUBRICATOR
. . . is self filling

Designation: A606 Perma Fog.

Features: Eliminates down-time required for manual filling. Built-in float automatically holds constant oil level in bowl. Oil is piped to the

lubricator at 10 to 100 psi over the air pressure on the lubricator. Minimum oil feed rate is in excess of any lubricator demand.

Specifications: Made in ¼, ⅜, ½, ¾ and 1 inch.

Watts Regulator Co.
Lawrence, Mass.

CIRCLE 312 ON TIME-SAVER CARD

AIR CYLINDER
. . . actuates ball valve

Features: Can be mounted on either side of pipe. One or more valves can be controlled manually or elec-

trically from a remote point. Valve can be operated by hand if air fails. For hazardous and hard to reach locations. For use with the company's Econ-o-miser ball valve.

Worcester Valve Co.
Worcester, Mass.

CIRCLE 313 ON TIME-SAVER CARD

Continued on next page

MEMO
Frank-
After the first couple of days, our V-rings don't seal worth a darn. Replacing them runs into money...and time. Is this necessary?
Charlie
MEMO
CHARLIE —
NO! R/M VEE-FLEX PACKING RINGS ARE DESIGNED TO PROVIDE AUTOMATIC SEALING ACTION OVER A LONG PERIOD OF TIME. SKETCH SHOWS HOW.
PLACE AN ORDER WITH R/M!
FRANK

Ordinary V-rings, with their flat surfaces, provide little or no automatic sealing action against the walls of the cylinder, with the result they quickly lose effectiveness. This means, of course, loss of power and eventually a maintenance problem. R/M Vee-Flex Packing Rings are specially designed to solve it for you. Convexly curved surfaces where the rings meet and thinner cross section at the apex of each V cause a flexing action which makes a firm seal on the shaft and stuffing box wall and between rings.

R/M Vee-Flex Rings are available in many compositions to meet the hazards of various applications: high temperatures, high pressures, fast cycling, corrosion, or combinations of these.

R/M's engineers have amassed a wealth of experience in manufacturing packings and gasket materials to meet the most exacting requirements of industry. This experience is at your disposal—call on R/M.

R/M
PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics
Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings
Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

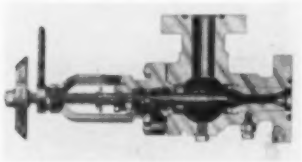
CIRCLE 140 ON TIME-SAVER CARD

NEW PRODUCTS

THROTTLING VALVE
. . . for pressures to 10,000 psi

Features: Meters flow accurately. Pointer and calibration plate indicate orifice opening. Tapered throat gives venturi effect for good flow characteristics. Tips can be made for any special flow condition.

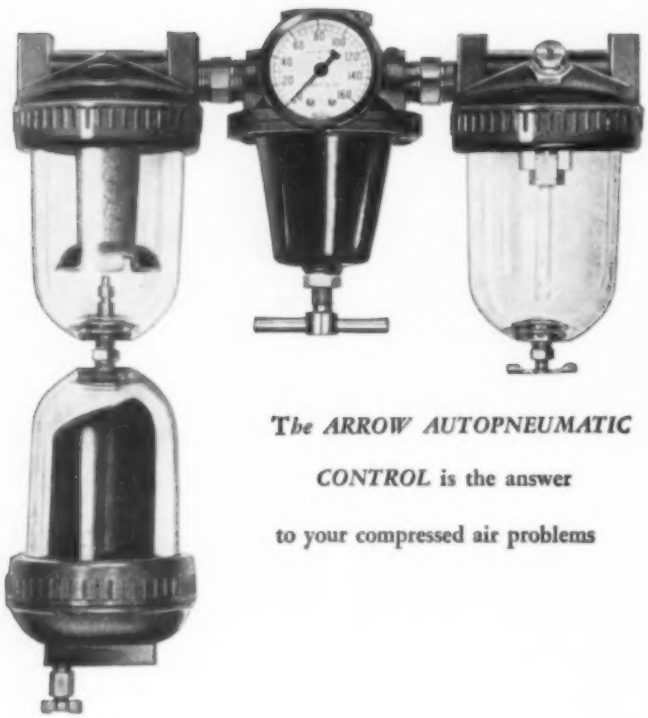
Specifications: Made in steel, bronze, aluminum, and stainless steel with flanged or threaded connections. Sizes 1 to 6 in. Can be



automatically actuated by air or hydraulic pressure.

Shaffer Tool Works
Brea, Calif.

CIRCLE 314 ON TIME-SAVER CARD



The ARROW AUTOPNEUMATIC CONTROL is the answer to your compressed air problems

Write for Free Catalog

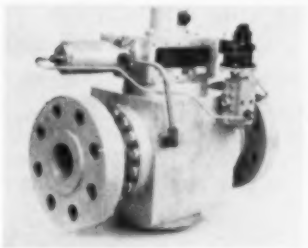
ARROW TOOLS, INC.
1934 S. Kostner Ave.
Chicago 23, Illinois

CIRCLE 14 ON TIME-SAVER CARD

BALL VALVE
. . . is fast operating

Features: Can fully open or close a 3-in. line in 7 milliseconds with gas or liquid pressures to 4000 psi and temperatures to 250 F. Unobstructed flow path for low pressure drop.

Operation: Electrical impulse trips a pilot valve opening a high pressure accumulator to a cylinder which rotates the valve. Accumulator will hold its charge for one year.



Application: Uses include high pressure missile fueling systems and aircraft catapult launchers.

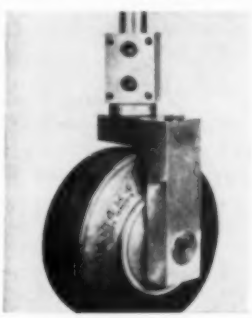
Hydromatics, Inc.
Livingston, N. J.

CIRCLE 315 ON TIME-SAVER CARD

HYDRAULIC WHEEL
. . . is self-propelled

Designation: Hydro-Wheel

Features: Propels any platform lift to 2000 lbs capacity. Just add a valve and bolt on the wheel. Oil lines from existing hydraulic system connected to swivel block. Will rotate both directions. Can be steered through 360 degrees.



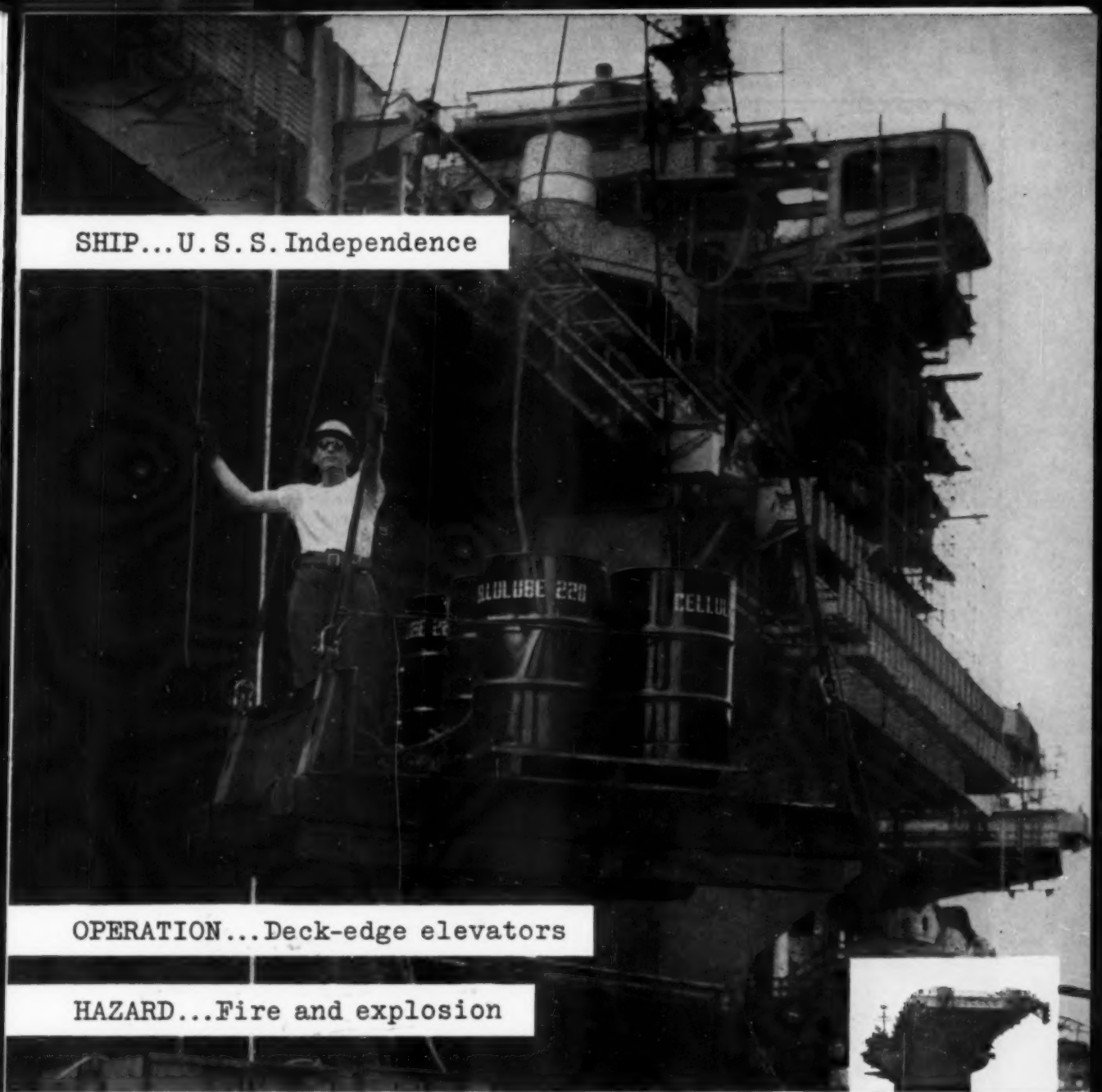
Specifications: At 1000 psi and 1.7 gpm speed is 2 mph. At 1200 psi thrust is all a man can pull. Torque efficiency 64% stalled, 74% running. Stalled leakage at 1000 psi is less than 50 cu in. per min.

Mechanisms Company
Uhrichsville, Ohio

CIRCLE 316 ON TIME-SAVER CARD

Continued on page 137

CIRCLE 28 →



Hydraulic Fluid Used...FIRE-RESISTANT CELLULUBES

Fifty-five gallon drums of Cellulube . . . part of a six-car train load . . . being put aboard the Independence to operate deck-edge elevators between hangar and flight decks.

The U. S. S. Independence, newest Navy supercarrier, recently christened and soon to be commissioned.

Thousands of gallons of Celanese Cellulubes . . . fire-resistant hydraulic fluids . . . have been loaded aboard the U. S. S. Independence, the Navy's newest 60,000-ton supercarrier. In fact, *all* of the ships in the Navy's great carrier fleet carry Cellulubes in the hydraulic systems of their deck-edge elevators . . . and on the mighty missile ships, atomic-powered submarine and destroyers, too, these functional fluids are doing their fire-safe hydraulic duty.

The Navy has long used Cellulubes, and industry, too, of course, has long depended on these outstanding hydraulic fluids . . . for power transfer and lubrication where sure resistance to flame and explosion, excellent lubricity, and unchanging viscosity are important. Cellulubes are available in six controlled viscosities, one of which is best suited to your particular operations and the safety of your plant. For evaluation samples, please let us know the application involved. Celanese Corporation of America, Chemical Division, Dept. 588-J, 180 Madison Avenue, New York 16, N. Y.

Celanese® Cellulube®

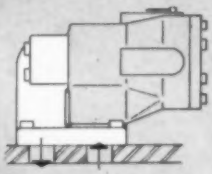
Cellulubes... Celanese fire-resistant functional fluids

CHEMICALS

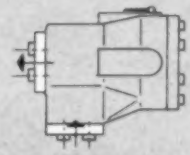
Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver • Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N.Y.

CIRCLE 108 ON TIME-SAVER CARD

PATENTS APPLIED FOR



White area indicates sub-plate mount. This mounting eliminates leaks, permits interchange of units of any capacity.



Standard SAE flanges (shown above in white) or threaded bodies are optional.

New Tell-Tale® Filters for 3000 psi Service are Sub-Plate Mounted

Now you can specify Rosaen Tell-Tale filters for use in pressure lines too! And as well as the Tell-Tale when-to-clean indicator, you get sub-plate mounting. This puts the filter on the control panel with the valves, makes it easy to check and service. For full-flow, 3000 psi service, the Tell-Tale pressure filter unit is available in four capacities: 10, 20, 30, and 60 gpm. As with the suction and return line Tell-Tale filters, filter cartridges are easily accessible for cleaning by removing the end plate. Write today for complete information.

The ROSAEN COMPANY

1776 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

Tell-Tale filters tell you when to clean, provide pressure-drop control

CIRCLE 53 ON TIME-SAVER CARD

GABB

FC-3500

TANK FILLER CAP

The Model FC-3500 is the first tank filler cap to successfully pass all test requirements of MIL-C-7244B (ASG) applicable to fuel, oil, alcohol-water and hydraulic reservoirs.

Lever action design permits cap to be opened safely under pressure and removed completely with only a 35° turn. Now available in 1.5, 2, 3, and 3.82" openings.

Write for free literature.

GABB SPECIAL PRODUCTS Inc.
WINDSOR LOCKS, CONN

AIR-MITE

HIGH PRODUCTION AIR PRESS

with more Quality Features

★ Solid Steel Column. Greater strength and rigidity.
★ Brass cylinder, aluminum end castings, Hy-Car piston cups.
★ Accurately ground table.
★ Fast set-up and stroke adjustment.

You don't have to "baby" an AIR-MITE Press because they're ruggedly built to stand the gaff of production work. From the tip of their solid steel column to the heavy base, they're every inch a workhorse tool. Feature-for-feature, you can't buy a better, more economical operating press than an AIR-MITE.

Special adaptations available. Write us your needs.

1 Ton Capacity
$89.95
F.O.B. Chicago

New 3 Way Control Valve. For safer, more efficient press work, use AIR-MITE Control Valves. Connected in parallel and positioned on either side of an air press, they provide a safe, instantaneous press operating control. Operator must depress both handles to actuate press . . . keeps attention on work-piece, hands out of the way. For pressures up to 160 p.s.i.

AIR-MITE Devices, Inc.

4401 W. KINZIE ST., CHICAGO, ILLINOIS

CIRCLE 7 ON TIME-SAVER CARD

FASTER CYCLING

WITH THE IMPROVED

C4H SERIES

- SHEFFER PIONEERED TAPERED CUSHIONS eliminate shock conditions on cushion entrance—permit faster cycling—greater production!
- 2000-3000 psi HYDRAULIC
- ALL STEEL CONSTRUCTION
- MEETS or EXCEEDS J. I. C.
- EASILY REMOVED ROD CARTRIDGE
- 12 BORE SIZES—17 MOUNTINGS
- FINEST OF "INTERCHANGEABLES"!

Write NOW for Bulletin No. 658

SHEFFER

THE SHEFFER CORPORATION

Cincinnati 15, Ohio • Phone: VAlley 1-0320

Manufacturers of the industry's most complete line of air and hydraulic cylinders

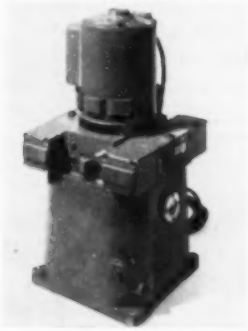
SOLD BY LEADING DISTRIBUTORS NATIONWIDE

CIRCLE 111 ON TIME-SAVER CARD

POWER PACK
. . . is compact

Designation: Circuitpak

Features: Valves manifolded for direct connection to cylinders. Return lines ported directly to tank. With valves in center position oil is under



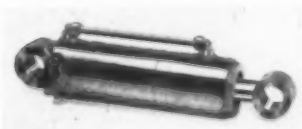
no pressure. Adaptable for conversion of mechanically operated equipment to hydraulic.

Specifications: Capacities 0.8 to 5 gpm. Up to four solenoid operated 4-way valves. Reservoir capacity two gallons with built-in heat exchanger. Motor speed 3600 rpm. Pressure 1000 psi.

Brown & Sharpe Mfg. Co.
Hydraulics Div.
Providence, R. I.
CIRCLE 318 ON TIME-SAVER CARD

HYDRAULIC CYLINDERS
. . . with built-in pilot check valves

Features: Insures positive piston lock in any position when directional valve is in neutral. Mounting in cylinder head eliminates need for



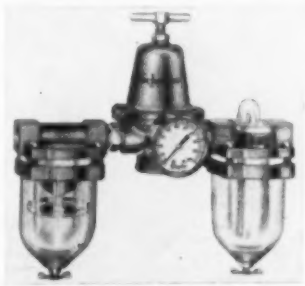
piping to separate valve. Can be made with single- or double-pilot check valves. Speed control is optional.

Benton Harbor Engineering Works, Inc.
St. Joseph, Mich.
CIRCLE 319 ON TIME-SAVER CARD

AIR LINE CONTROLS
. . . are compact

Designation: Lub-Air-Ator

Features: Can be serviced without moving piping. Regulates from 5 to 125 psi. Sintered bronze filter has



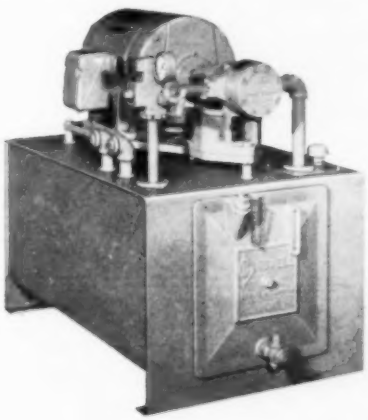
low pressure drop and is easily cleaned. Filter's whirling action throws water and dirt particles out of air stream. Standard bowl for 150 psi, metal bowl for higher pressures. Lubricator is adjustable and corrosion resistant.

Specifications: Made in ¼, ⅜, ¾, and 1 inch NPT.

A. Schrader's Son
Division of Scovill Mfg. Co., Inc.
Brooklyn, N. Y.
CIRCLE 320 ON TIME-SAVER CARD

Continued on next page

CARDWELL STANDARD HYDRAULIC POWER UNIT



SEVERAL HUNDRED POSSIBILITIES! Now, from one Cardwell Catalog, you can specify a "tailored-to-fit" Hydraulic Power Unit from a combination of Cardwell standard parts.

WRITE TODAY for this catalog which describes the new Cardwell Hydraulic Program in detail, including drawings, specifications and price sheets.

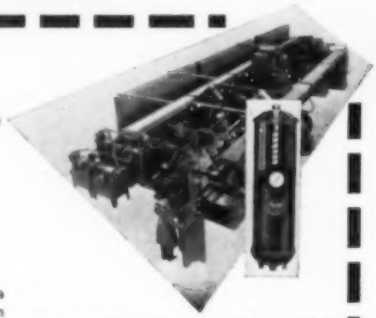
DEALERS and DISTRIBUTORS will want this new program, too! One catalog gives you a complete line of Standard Hydraulic Power Units. Write or phone . . .

The CARDWELL MACHINE COMPANY
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

CIRCLE 27 ON TIME-SAVER CARD

CIRCLE 24 ON TIME-SAVER CARD

IF YOU DESIGN OR OPERATE MODERN ACCURACY-DEMANDING EQUIPMENT . . . FIND OUT WHAT "BRIGGS HYDRAULIC CONTROL" REALLY MEANS.



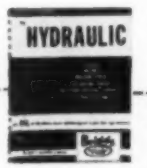
. . . A LITTLE lost pressure here . . . a sticking valve there, yes, contamination can raise havoc with even the simplest device . . . BUT properly designed and engineered HYDRAULIC CONTROL can whip the weakest link in any producing chain. A complete Briggs operating manual is yours for the asking.

Showing 25 station Le Maire "PRODUCER." Completely machines three different styles of truck manifold castings in 55 seconds. Briggs hydraulic filter installed on all of these Le Maire "PRODUCERS."

Briggs
PIONEERS IN MODERN OIL FILTRATION

OIL FILTERS
• FILTER/SEPARATORS • HYDRAULIC FILTERS • AIR/GAS LINE FILTERS

WRITE, TODAY, NO OBLIGATION.



THE BRIGGS FILTRATION COMPANY, DEPT. 267, WASHINGTON 16, D. C.

YES! Please send operating manual at no cost or obligation.

Name .....

Company .....

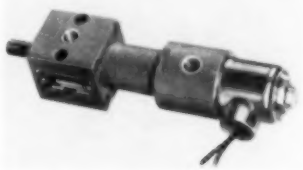
Address .....

NEW PRODUCTS

AIR CYLINDERS
. . . with integral valve

Designation: 33800 series

Features: No piping to install and instant piston response. Optional flow controls for piston speed in



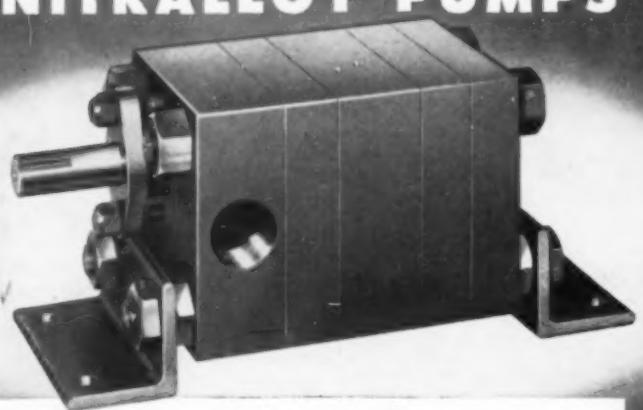
either direction. For use with clamps, knockouts or release mechanisms.

Specifications: Cylinder bore sizes 1, 1⅛, 1½, 2, 2½, and 3-inch, strokes from 1/16 inch. Pressures to 200 psi. Mountings, front face or foot. Twenty-million cycles without breakdown.

Airmatic Valve, Inc.
Cleveland, Ohio

CIRCLE 321 ON TIME-SAVER CARD

NORTHERN NITRALLOY PUMPS

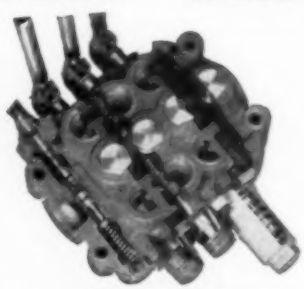


Unique block construction permits selection from a wide choice of metals for virtually any pumping need. Proven in thousands of installations . . . backed by 50 years of engineering and production experience. Unexcelled for precision manufacture, accurate assembly and dependable, long-life operation. Pressures to 2,000 PSI. Capacities from ¼ to 146 GPM. *Write for free catalog and engineering data.*

NORTHERN ORDNANCE, INCORPORATED
Subsidiary
NORTHERN PUMP COMPANY
MINNEAPOLIS 21, MINN.

CIRCLE 89 ON TIME-SAVER CARD

NEW HUSCO "3200" VALVE



- Choice of ONE to SIX plungers, with sealed ends—in completely balanced design.
- FOUR Control Positions—raise, lower, float, neutral—with or without detent.
- Pilot-Operated Relief permits setting to maximum of 50 *lb. variation*—for H.P. savings.
- Accurately rated capacity—35 G.P.M.—with high pressure carryover.

Check HUSCO first for modern hydraulic units engineered to your specific needs—cylinders, control valves, rotary swivels, selector valves, and others. Write or phone—

HUSCO
HYDRAULIC UNIT SPECIALTIES CO.
Pumps • Valves • Cylinders
P. O. Box 257-A, Waukesha, Wis.

CIRCLE 71 ON TIME-SAVER CARD

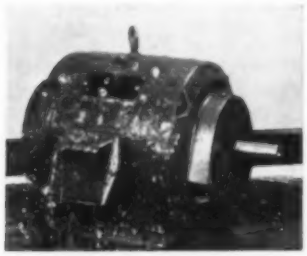
GAGE SNUBBER
. . . has built-in flow check

Features: Porous stainless steel snubber prevents surges. Free piston on upstream side isolates the instrument from pressure media. If line to instrument ruptures, piston closes port to prevent escape of flammable or toxic liquids. For pressures to 30,000 psi. Will work with bourdon tube or diaphragm-operated instruments.

Chemiquip Co.
New York, N. Y.
CIRCLE 322 ON TIME-SAVER CARD

ELECTRIC MOTOR
. . . is completely weatherproof

Features: Exceeds NEMA splashproof requirements. All external

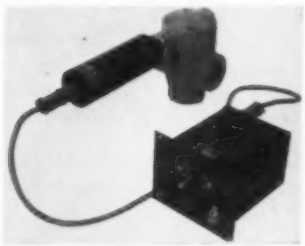


parts are corrosion-proof cast iron. Shaft openings sealed by cap and slinger. Windings are water and oil resistant. Rotor and stator are coated with rust inhibitor. Cast iron conduit box with gasket and threaded outlet. Bolts are non-corrosive. Stainless steel nameplate. Made in all standard speeds from 1 to 100 hp.

Reliance Electric and Engineering Co.
Cleveland, Ohio
CIRCLE 323 ON TIME-SAVER CARD

RELIEF VALVE ACTUATOR
. . . weighs only 1¾ lb

Features: Motorized and is mounted on the relief valve in place of hand



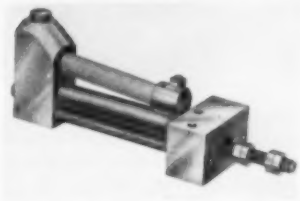
adjustment. Can be made with two-speed control to give accurate settings. Has limit switches for normally-open and normally-closed settings. Limits can be set for two pressures within the range of relief valve. Wide range of actuator speeds give any desired time for full-stroke actuation.

United Hydraulics, Inc.
Dayton, Ohio
CIRCLE 324 ON TIME-SAVER CARD

HYDRAULIC CHECK
. . . for air cylinders

Designation: Stedifeed

Operation: Consists of oil-filled checking cylinder, adjustable metering valve, and reservoir. Installed by attaching mounting head to fixed



base, and piston rod to member to be controlled. As rod is pulled out,

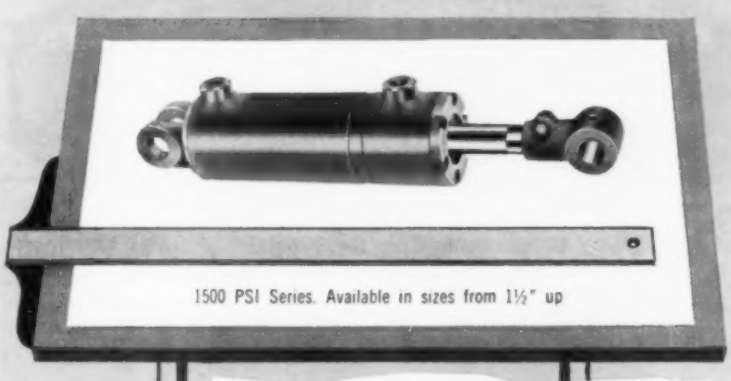
Continued on next page

BH EW

DOUBLE ACTING GENERAL PURPOSE

Hydraulic Cylinders

WITH ADJUSTABLE ROD ENDS



1500 PSI Series. Available in sizes from 1½" up

BHEW's Double Acting General Purpose Cylinders, designed around standard components, are the basic elements of custom cylinders. Flexibility in standard parts means BHEW can supply a cylinder to fit almost any application. Available in a variety of mountings (pin eye is standard), with adjustable or non adjustable rod ends and with or without rod ends. Self-adjusting "V" packed rod glands and "U" cup seal on pistons.

- Honed steel barrel
- High tensile, hard chrome plated rods
- Packings available for extreme high and low temperatures and most non-inflammable fluids
- Delivery schedules and lead times rigidly maintained

Tell Us Your Design or Application Problems. We'll Work with You to Solve Them.

WRITE TODAY!
FREE copy of Hydraulic Cylinder Engineering Reference Data saves hours of time in specifying cylinders. 78 dimensioned basic designs for general and special purpose single-and double-acting cylinders.

BENTON HARBOR BH EW ENGINEERING WORKS, INC.
622 Langley Avenue St. Joseph, Michigan

CIRCLE 23 ON TIME-SAVER CARD

NEW PRODUCTS

piston in the checking cylinder forces oil through an adjustable metering valve into the reservoir and back to opposite end of checking cylinder. Open system gives instantaneous bleed-off of air preventing airlock.

Burklyn Co.
Los Angeles, Calif.

RETAINING RINGS
. . . in handy kit form

Features: Contains 376 cadmium plated Truarc retaining rings packed individually in numbered envelopes. Shaft sizes ¼ to 2½ in. Rings meet national aircraft standards NAS 669 and 670. Sizes cover 70% of the retaining rings being used in industrial, automotive, and aircraft applications.
Plating insures that rings will have long life in the kit or installed in equipment. Both external and universal crescent ring design. Complete interchange information furnished with each kit.

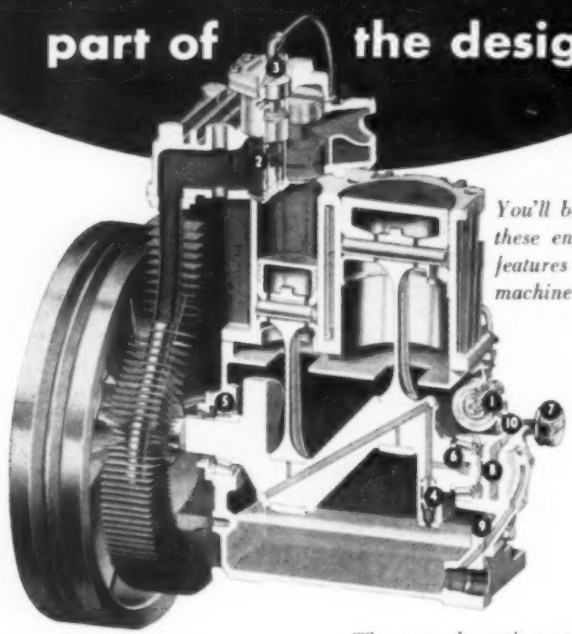
Bearings Inc.
Cleveland, Ohio

CIRCLE 326 ON TIME-SAVER CARD

Use A TIME-SAVER CARD for complete information on new products.

WHEN COMPRESSED AIR IS PART OF THE PRODUCT

make QUINCY compressors part of the design



You'll be adding these engineering features to YOUR machine design

1. Simple hydraulic unloader valve.
2. Low-lift, high pressure intake valve.
3. Diaphragm and unloader assembly.
4. Centrifugal-closing oil spill valve in crankshaft.
5 - 6. Oversize Timken roller bearings.
7. Easy reading oil pressure gauge.
8. Discharge oil passage in bearing carrier.
9. Intake oil passage (crankcase to pump).
10. Passage to hydraulic unloader valve.

These are the main parts of Quincy Safe-O-Lube system—the most advanced pressure oiling and loadless starting system available in a compressor. Get full details—mail coupon today.

MAIL TODAY!

Quincy COMPRESSORS
COMPRESSOR CO.
Dept. AH-1058,
Quincy, Illinois

Gentlemen: Send free catalog of industrial air compressors, and literature describing Safe-O-Lube.

NAME
FIRM
ADDRESS
CITY ZONE STATE

CIRCLE 101 ON TIME-SAVER CARD

PRESSURE SWITCH
. . . for 5000 psi

Features: Designed for tough industrial applications. Has a strain-relief mechanism to prevent damage from shock and pressure surges.

Oil-tight construction. Operates at 300 cycles per minute. Can be set from 550 to 5000 psi. Externally adjusted. Indicator on front shows pressure setting.

Square D Co.
Milwaukee, Wis.

CIRCLE 327 ON TIME-SAVER CARD

BELLOWS
. . . has controlled wall thickness

Features: Made without drawing or forming. Machined from aluminum alloys or Inconel-X for high temperatures. Wall thickness is increased at points of high stress. Tested for 100,000,000 cycles without fatigue.

Specifications: For pressures to 3000 psi. Sizes ¼ to 60 in. dia.

The Hydrodyne Corp.
North Hollywood, Calif.

CIRCLE 328 ON TIME-SAVER CARD

CIRCLE 60 ON TIME-SAVER CARD

NEW

SINGLE OR 2-SPOOL VALVE

MODEL WP

PARALLEL VALVE

for heavy duty industrial mobile hydraulic applications

GRESEN HYDRAULICS

Capacity: **40 GPM** at 20 ft./sec.

MAX. PRESSURE: 1500 PSI

Features:

SPOOLS – fully balanced, self centering, accurately feathered for fine metering action – separate ball checks for each spool.

CARTRIDGE type relief valve has hardened seat.

TRIPOD mounting feet for easy installation.

CHOICE of many modifications.

WRITE FOR LITERATURE

GRESEN *Mfg. Co.*

405 35th Ave. N.E., Minneapolis 8, Minn.

CIRCLE 43 ON TIME-SAVER CARD

Use a Wrench–Not a Hammer to Install Flexible Couplings

Damage to shafts and couplings is avoided when the Magnaloy Series B Coupling is used. It features a separate, interchangeable, split hub which slips over the shaft end easily. Drawn to the coupling half by socket-head screws, tapered mating surfaces exert a vise-like grip on the shaft. The same screws, in other holes, release the coupling from the shaft. Learn more about Magnaloy couplings. Write today for the Magnaloy Catalog.

DETROIT POWER COUPLING CO.

992 West Seven Mile Road • Detroit 3, Michigan

Series B

Series A

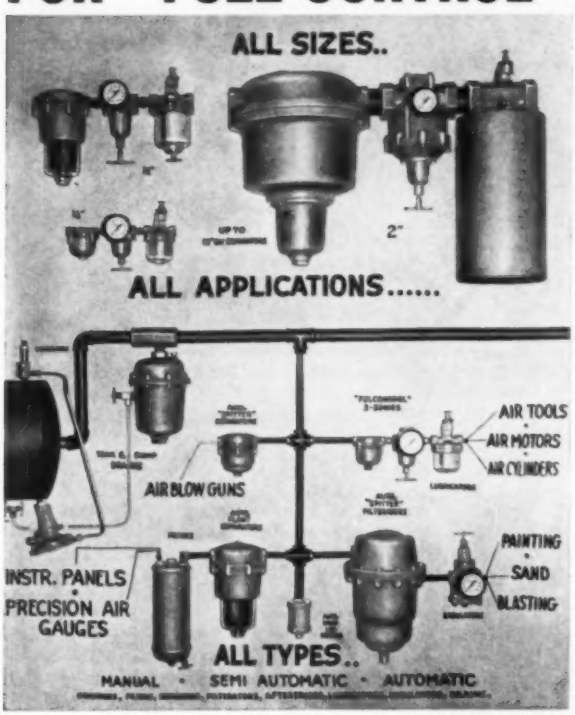
Attention Representatives

MAGNALOY

FLEXIBLE DRIVE COUPLINGS

PATENTS PENDING

MOST COMPLETE LINE OF PNEUMATIC UNITS FOR "FULL CONTROL" OF ALL AIR LINE USES



Compare These Features:

FILTERS

- Patented Automatic Petcock, Manual Petcock Available, float or piston operated drain.
- Can be converted from one to the other without new units.
- Remove particles as small as five microns in size.
- Metal or transparent bowls.
- Larger sump capacities.
- Take out moisture, oil fumes, rust and other contaminants.

REGULATORS

- Tee Handle or Tamper Proof external adjustment.
- Gauge mounts on either side.
- Will not chatter.
- Automatically self relieving.
- Low pressure drop.

LUBRICATORS

- Two large fill holes—one on either side accessible.
- Fill them while air is on.
- Sight gauge to check operation.
- Regular Knob or Tamper Proof external adjustment.
- Lubricates 1 CFM to 1200 CFM.
- 3.5 oz. bowls to 5 gal. bowls, metal or transparent.
- ¼ inch to 2 inch pipe sizes.
- Have petcock as standard.
- Force feed type—no wick.
- Automatic filling type also available.

AUTOMATIC DRAINS

- To drain Tanks, Sumps and Drop Legs.

YOU CAN STANDARDIZE ON WILKERSON PRODUCTS TO COMPLETELY AUTOMATE YOUR AIR LINES

Send for Single Unit Catalog No. 157 and New Combination Catalog No. 571, or

Find Your WILKERSON Distributor In The Yellow Pages

WILKERSON CORPORATION

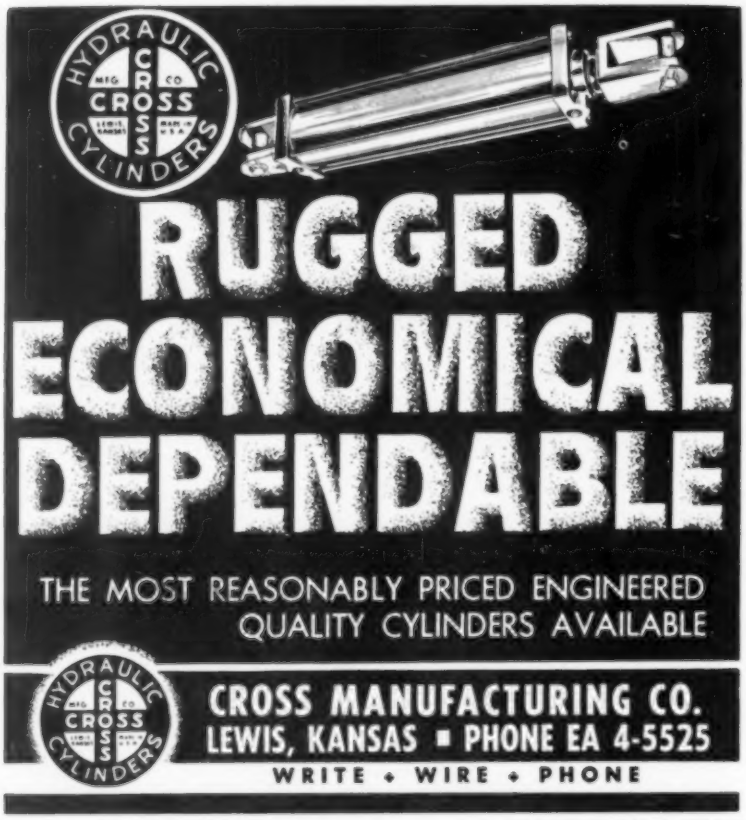
"Dedicated to keeping the NEW in pNEUmatics"

1643 W. GIRARD AVE., ENGLEWOOD, COLORADO

USE "DEP'T ID" WHEN ADDRESSING INTERNATIONAL DIV.

CIRCLE 136 ON TIME-SAVER CARD

CIRCLE 38 ON TIME-SAVER CARD



USEFUL LITERATURE

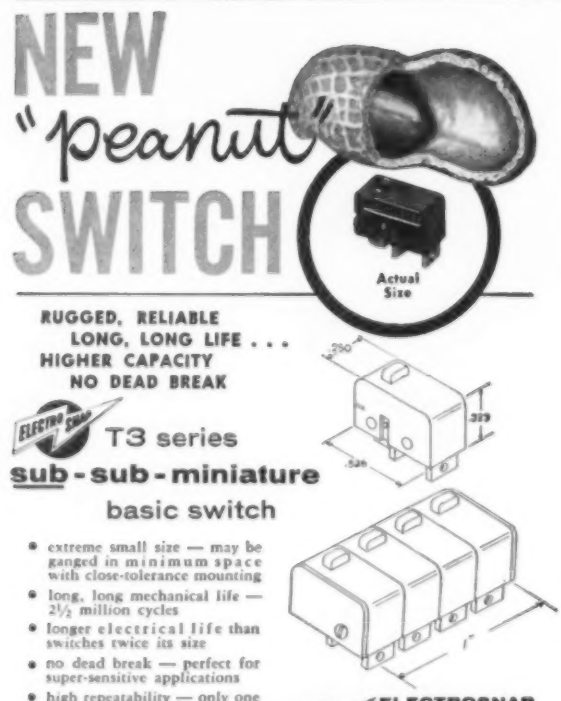
FLOW REGULATORS . . . for pressures to 3000 psi and flows to 100 gpm are detailed in a 16-page bulletin published by *Waterman Engineering Co., Evanston, Ill.* It includes the company's full range of adjustable and fixed-flow regulators. Sectional illustrations and dimension drawings are given for all models.

CIRCLE 411 ON TIME-SAVER CARD

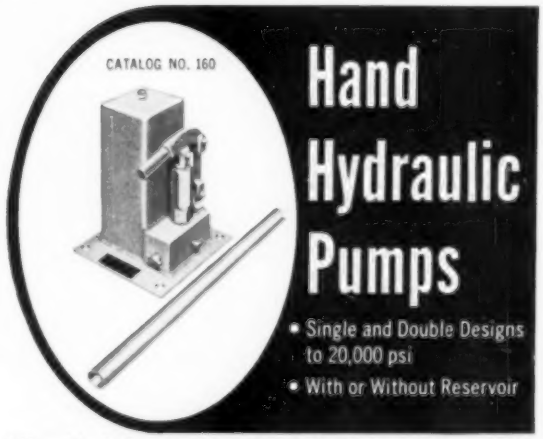
DIGITAL INDICATORS . . . using principles of servo null-balance are discussed in Bulletin 1758 released by *Performance Measurements Co., Detroit, Mich.* It describes the many types of transducer pickups used with the indicator, and illustrates applications.

CIRCLE 412 ON TIME-SAVER CARD

STRAIGHT-THREAD FITTINGS . . . designed to replace pipe thread and O-ring styles are covered in a 4-page illustrated folder from *Flodar Corp., Cleveland, Ohio.* It describes the fittings which require no O-ring


NEW
"peanut"
SWITCH
Actual Size
RUGGED, RELIABLE
LONG, LONG LIFE . . .
HIGHER CAPACITY
NO DEAD BREAK
ELECTRO SNAP
T3 series
sub-sub-miniature
basic switch
• extreme small size — may be ganged in minimum space with close-tolerance mounting
• long, long mechanical life — 2½ million cycles
• longer electrical life than switches twice its size
• no dead break — perfect for super-sensitive applications
• high repeatability — only one moving part besides button
• rugged, durable high temperature and impact resistant case
WRITE FOR MORE DETAILS
ELECTROSNAP CORPORATION
Switch Division
4224 W. Lake Street
Chicago 24, Illinois
Telephone: VAn Buren 6-3100
TWX NO. CG-1400

CIRCLE 47 ON TIME-SAVER CARD



160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WILLIAM S. PINE

hydraulic hand pumps for 1001 uses

1635 East 22nd St., Los Angeles 11, Calif.

CIRCLE 96 ON TIME-SAVER CARD

and have a metal-to-metal seal. The folder M-57 gives a description of the fittings and installation instructions.

CIRCLE 413 ON TIME-SAVER CARD

THERMAL RELIEF VALVE . . . with accurate response to pressure variations is covered in a data sheet from *Fluid Regulators Corp., Painsville, Ohio.* It gives complete dimensions and engineering information on the valve which has a capacity of 3.5 gpm and a temperature range of —65 to 280 F.

CIRCLE 414 ON TIME-SAVER CARD

AIR LINE CONTROLS . . . including automatic moisture separators, lubricators, regulators, and filters are described in Catalog 157

prepared by *Wilkerson Corp., Englewood, Colo.* In addition it covers the automatic filtering of oil contaminants down to three microns.

CIRCLE 415 ON TIME SAVER CARD

FIRE-RESISTANT FLUIDS . . . and hydraulic packings that meet government specifications are shown in a booklet prepared by *E. F. Houghton & Co., Philadelphia, Pa.* Both the water-glycol and phosphate ester type fluids are described with recommended and government approved packings for each.

CIRCLE 416 ON TIME-SAVER CARD

MARINE FLUID POWER . . . is discussed in a problem-solution type of presentation in Fluid Power News No. 7 released by *The Oilgear Co., Milwaukee, Wis.* Covered are, an electro feedback hydraulic servo-control system for steering, hydraulic muscle for offshore oil drilling barge, high-speed ship freight elevator, and power packs for marine steering gears.

CIRCLE 417 ON TIME-SAVER CARD

SILICONE FLUIDS . . . for use in hydraulic transmissions, couplings, and for damping, and springing are presented in an 8-page engineering guide prepared by *Dow Corning Corp., Midland, Mich.* Tables, graphs, and figures complement detailed information on the properties that enable silicone fluids to increase efficiency.

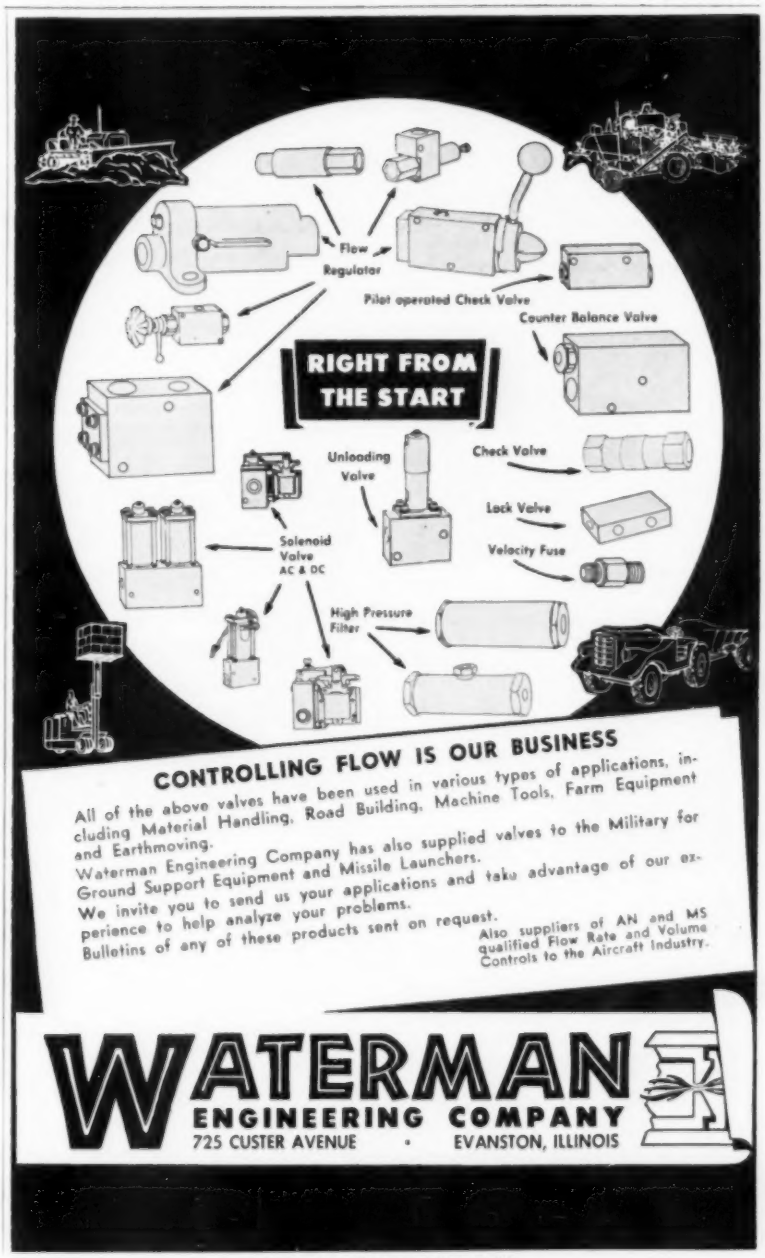
CIRCLE 418 ON TIME-SAVER CARD

PRESSURE REDUCING VALVES . . . of sliding gate design are described and illustrated in a 4-page folder prepared by *Jordan Corp., Cincinnati, Ohio.* Included are capacity charts, dimension drawings, and cutaway views of the company's complete line of ¼ to 6-inch valves.

CIRCLE 419 ON TIME-SAVER CARD

FOUR-WAY VALVE . . . called the Spherotor for pressures to 3000 psi is described in a bulletin published by *Sarasota Precision Products Inc., Sarasota, Fla.* Features of the valve are low turning torque under high operating pressures. High flow capacity with low pressure drop, and simple construction for easy maintenance.

CIRCLE 420 ON TIME-SAVER CARD


Flow Regulator
Pilot operated Check Valve
Counter Balance Valve
RIGHT FROM THE START
Unloading Valve
Check Valve
Lock Valve
Velocity Fuse
Solenoid Valve AC & DC
High Pressure Filter
CONTROLLING FLOW IS OUR BUSINESS
All of the above valves have been used in various types of applications, including Material Handling, Road Building, Machine Tools, Farm Equipment and Earthmoving.
Waterman Engineering Company has also supplied valves to the Military for Ground Support Equipment and Missile Launchers.
We invite you to send us your applications and take advantage of our experience to help analyze your problems.
Bulletins of any of these products sent on request.
Also suppliers of AN and MS qualified Flow Rate and Volume Controls to the Aircraft Industry.
WATERMAN
ENGINEERING COMPANY
725 CUSTER AVENUE • EVANSTON, ILLINOIS

CIRCLE 123 ON TIME-SAVER CARD

New Disc Design

GIVES YOU GREATER FILTERING AREA!

RIPLEY SUMP STRAINER

GPM	Filter Area
5	61 sq. in.
8	92 sq. in.
10	122 sq. in.
20	218 sq. in.
30	311 sq. in.
50	370 sq. in.
75	471 sq. in.

You'll find Ripley Strainers provide long, low-cost, trouble-free protection for your hydraulic equipment. Their self-cleansing discs have no crevices to clog or reduce flow—are assembled in standard combinations to give you *maximum* filtering area in *any* rated size! Available in sump and line models to meet your exact requirements. Send for complete information today!

RIPLEY LINE STRAINER

GPM	Filter Area
5	61 sq. in.
8	92 sq. in.
10	122 sq. in.
20	218 sq. in.

35 years of experience in the manufacture of screens and strainers.

Ripley MANUFACTURING CO.
Filter Division
32749 Northwestern Highway • Farmington, Michigan

Filter Division
RIPLEY MANUFACTURING CO.
32749 Northwestern Highway, Farmington, Mich.
Gentlemen: Please send me complete information on your new disc type Sump and Line Strainers.
☐ Name of nearest stocking distributor.

Name_____
Title_____
Company_____
Address_____
City_____ Zone____ State_____

CIRCLE 106 ON TIME-SAVER CARD

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Yates-American Machine Company, Beloit, Wis., appointed **Donald W. Smith** as national sales manager of the heat transfer products division. Smith's appointment is keyed to a current program of the division's expansion.

Tube Reducing Corp., Wallington, N. J., has promoted two engineers to administrative posts. **Frederick P. Huston** to chief methods engineer and **Scott N. Randall** to chief product engineer.

Flexonics Corp., Maywood, Ill. has formed four regional sales offices. The new offices are to be headed by regional sales managers. **L. J. Cullen,** midwest, at Maywood, Ill.; **R. G. Arnold,** central, at Inkster, Mich.; **H. V. Tastrom,** eastern, at Elizabeth, N. J.; and **G. W. Derum,** western, at Santa Ana, Calif.

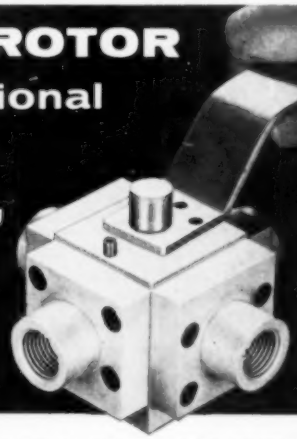
Fisher Controls Inc., Santa Monica, Calif., appointed **Marsh Equipment Company** as their representatives in the State of Michigan.

Continued on page 146

NEW **SPHEROTOR**

4-Way Directional Control Valve

- Open or Closed Center
- 0 to 3000 psi Operating Pressure
- For High Flow Capacity With Low Pressure Drop
- Low Turning Torque
- Tight Seal



■ The new SPHEROTOR permits easy valving of fluids under high operating pressure and eliminates the need for larger valves to handle desired flow.

In addition to its low cost, the SPHEROTOR is small, simply constructed and easily maintained. Its metal-to-metal seals are both spring and pressure loaded for positive sealing. Individually attached ports can be selected, changed or serviced without special tools.

- Oil, non-corrosive fluids and lubricated air.
- Available off-the-shelf in ¼", ⅜" and ½" pipe sizes.
- SAE and AND ports made to order without additional cost.

FLOW PATTERNS

Open Center

Closed Center

Write for free detailed literature.

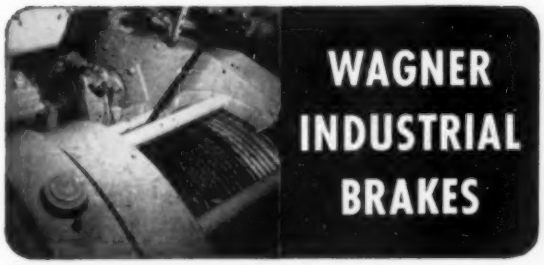
Designers and Manufacturers of Hydraulic Valves & Devices

SARASOTA **Precision products inc.**

1314 N. LIME AVENUE • SARASOTA, FLORIDA

CIRCLE 144 ON TIME-SAVER CARD

CIRCLE 132 ON TIME-SAVER CARD

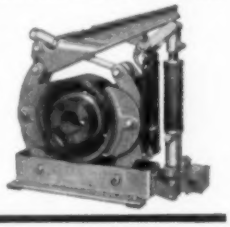


WAGNER INDUSTRIAL BRAKES

will "hold" that hydraulic winch

In fluid power applications, Wagner spring-applied hydraulic-released Industrial Brakes are finding increasing use for holding and stopping hydraulic motor drives. Special mineral oil or hydraulic brake fluid compatible parts and cast steel or malleable iron construction provide a brake to meet your needs. Wagner also supplies standard Actuating Systems for remote brake control.

Your Wagner Sales Engineer is backed by men with years of experience in braking and control system design. Let him help you solve your application problems. Write for Wagner Bulletin IU-226.



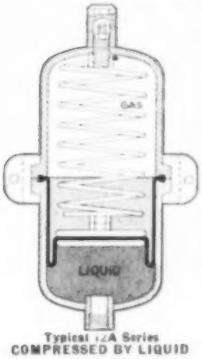
Wagner Electric Corporation

W150-2 6387 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U. S. A.

NEW SPeeCo ACCUMULATORS

—Easily Maintained
—More Economical
—Efficient
—All Sizes

—for most economical operation of industrial, farm and domestic hydraulic systems
• 15 to 7500 cu. in.



Typical 12A Series
COMPRESSED BY LIQUID

GAS VALVE and Protector Cap.

SPRING—Pulls up bottom of Separator Hat and prevents side from collapsing.

GAS CHAMBER—Nitrogen precharged, to a suitable pressure.

STEEL SHELL—Of two sections. Designed to withstand working pressure up to 2000 Psi.

CLAMP RING—Holds sections together. Easily removed. Holds firmly.

BARRIER—Hat Shape of synthetic rubber. "O" ring seals sections. Convolutes inside-out as liquid builds required pressure.

INNER AND OUTER PLATES—Starts convolution and prevents extrusion through liquid port.

FEMALE PIPE THREADS can be provided to meet customer's specifications.

Thorough cleaning and maintenance is quickly performed when required.

Send for specifications and descriptive literature at once.

SPECIAL PRODUCTS CO.

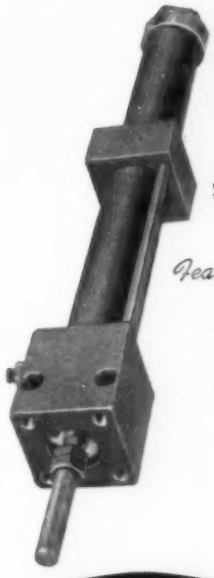
15000 West 44th Ave.
GOLDEN, COLORADO

CIRCLE 116 ON TIME-SAVER CARD

CIRCLE 8 ON TIME-SAVER CARD

a NEW DASHPOT...

HYDRAULIC CHECK • SHOCK ABSORBER



Airoyal now offers a complete line of pull-type Dashpot Cylinders. These are available in 3 sizes, for pull loads of 480, 1200 and 3000 pounds. Standard strokes for each size are 2", 4" and 6".

Features:

- **May be mounted in any position**
- **Low controlled-speeds**
- **High return-speeds**
- **In-line integral oil reservoir**

Dashpot Cylinders carry the standard Airoyal guarantee: they are unconditionally guaranteed against breakage—forever!

THE AIROYAL MFG. CO

FLUID POWER EQUIPMENT

1990 SPRINGFIELD AVENUE
MAPLEWOOD, NEW JERSEY

CLOSURES

- **Metal or Plastic Caps or Plugs to protect threads, tubes, machined parts, reamers, cutters, tools.**
- **Protect against thread damage, dust, dirt, and moisture.**
- **For inside and outside application. All sizes. Immediate delivery.**

METAL Caps to cover AN & SAE threads

PLASTIC tapered caps and plugs

METAL plugs for AN & SAE threads

PLASTIC tube cap for AN & SAE parts

Clover closures are made in metal and tough plastic polyethylene. They are made in caps, plugs and special shapes to fit parts tightly, offering completely sealed protection during manufacture, shipping and storage. Backed by years of closure experience. Write for low prices and complete information.

Send coupon today!

Gentlemen: Please send samples and prices of closures in Polyethylene ☐ Aluminum ☐

Name.....

Address.....

City.....

CLOVER INDUSTRIES, INC. 378 Young Street Tonawanda, N. Y.

CIRCLE 33 ON TIME-SAVER CARD

POST SCRIPTS OF INDUSTRY

Commercial Plastics & Supply Corp., New York was named an authorized distributor for the **Polymer Corp.,** Reading, Pa. It will stock and service the metropolitan New York area, part of Connecticut and New Jersey.

Titeflex Inc., Springfield, Mass., has opened a new plant in Santa Monica, Calif. to be known as **Titeflex-Pacific Div.** Complete metal processing, assembly, and testing equipment will enable them to manufacture all of the firm's hose products.

T. F. Hudgins & Assoc., Inc., Houston, Texas was named sales representative for **Berry Hydraulics,** Pittsburgh, Pa. The company will offer sales and engineering representation for Berry pumps and motors, with emphasis on the gas transmission and chemical industries.

The Paquin Co. of Cleveland and Dayton, Ohio, representatives and stocking distributors of fluid power equipment, named **Fred Wyss** vice-president in charge of industrial sales and, **Al Pitman** vice-president and plant manager for all operations in Ohio. Pitman has been with the company since its founding in 1950. Wyss had been research engineer at Weatherhead Co. before joining Paquin in 1952.

Fred Wyss
Paquin Co.

H. E. Wahlstrom
Hydraquip Corp.

Harold E. Wahlstrom who for the past several years has been sales engineer for Racine Hydraulics & Machinery, Inc., Racine, Wis., will join **Hydraquip Corp.,** Texas representative of Racine, as sales manager.

Hanna Engineering Works, Chicago, Ill., has appointed two new representatives. **Jay Instrument & Specialty Co.** with headquarters in Cincinnati will cover parts of Ohio, Indiana, and Kentucky. According to Ray Birkmeyer, president of Jay, the company was founded only four years ago and their sales forecast for this year is 1.3 million dollars. Hanna also appointed the **W. F. Hartfiel Co.,** Minneapolis, Minn., as representatives for Minnesota, western Wisconsin, and eastern North Dakota.

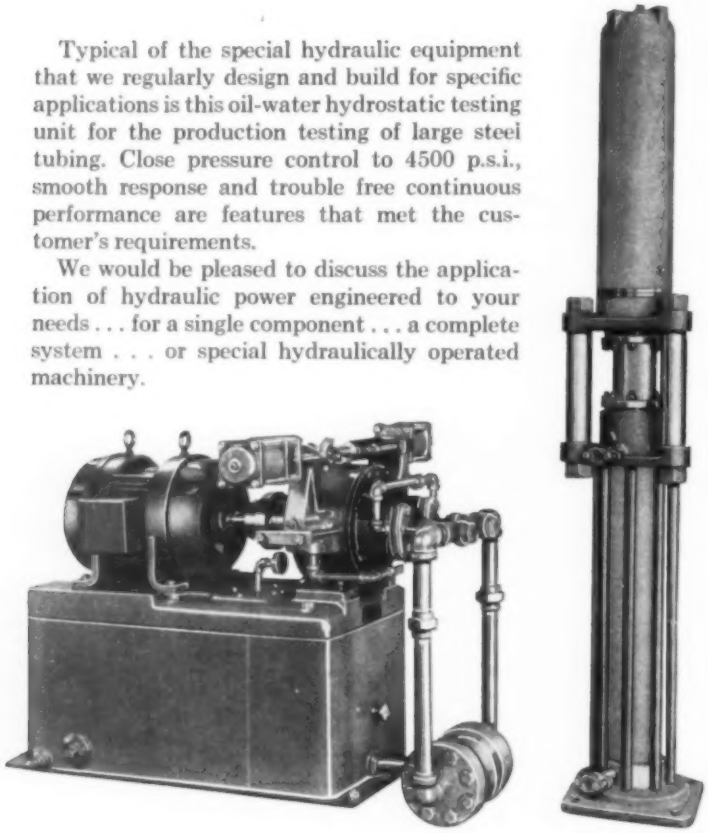
Del H. Hiebert has joined the **Alta Engineering Co.,** Englewood, Colorado, to head their new Instrument Division.

Continued on page 148

it's Lassman for fast, accurate PRESSURE TESTING

Typical of the special hydraulic equipment that we regularly design and build for specific applications is this oil-water hydrostatic testing unit for the production testing of large steel tubing. Close pressure control to 4500 p.s.i., smooth response and trouble free continuous performance are features that met the customer's requirements.

We would be pleased to discuss the application of hydraulic power engineered to your needs . . . for a single component . . . a complete system . . . or special hydraulically operated machinery.



Quality EQUIPMENT for *Quality* PERFORMANCE

BENJAMIN LASSMAN & SON Route 8, GLENSHAW, PA.

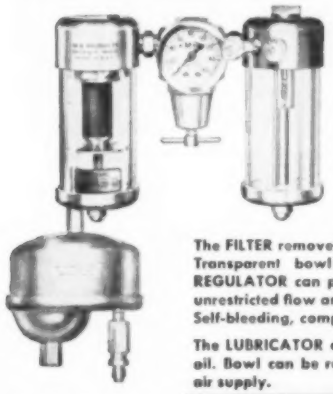
CIRCLE 80 ON TIME-SAVER CARD

CIRCLE 85 ON TIME-SAVER CARD

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

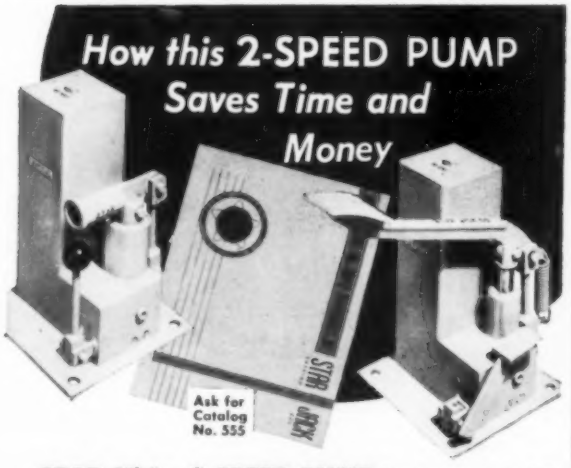
The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M·B PRODUCTS
46 VICTOR AVE., Div. 18
DETROIT 3, MICHIGAN

How this 2-SPEED PUMP Saves Time and Money



STAR Hi-Lo 2-SPEED PUMP (hand or foot model) operates at high speed, brings ram to load 6 to 15 times faster than a single speed pump, then automatically changes over to high pressure. Maximum capacity 10,000 psi.

SPEEDS WORK, SAVES EFFORT

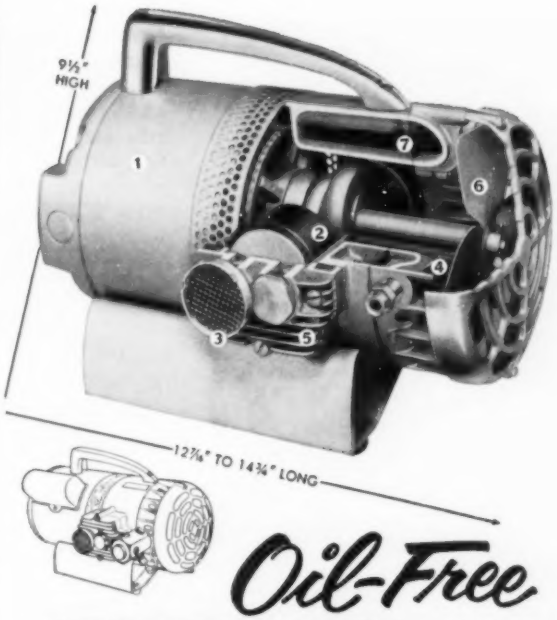
Safety overload valves, oil capacity 160 cu. in. or larger, chrome plated concentric pistons 1¼" and ½", 1½" and ½", 2" and ½", all with 1½" stroke.

Special engineering counsel and proposals cheerfully submitted on request.

Representative areas available.

STAR JACK CO., INC.
420 LEXINGTON AVE., Dept. AH, N.Y.C. 17
PLANT: RIVER GROVE, ILLINOIS

CIRCLE 118 ON TIME-SAVER CARD



Oil-Free COMPRESSED AIR

CLEAN, COOL, DRY... FROM THIS PORTABLE OR BUILT-IN UNIT

Here is a compressor which doesn't need lubrication of any kind—eliminates an oil separator—*ends expensive lubrication maintenance.* Where else can you find all these features—

Easily carried portable model.

"Duplex Unit," mounted on horizontal tank.

1 **Special motors.** Built by B&G—ball bearings *permanently* grease packed.

2 **Graphite piston rings and skirts.** Never need lubrication—operate for years without destroying mirror-finish of cylinder walls.

3 **Dry valve construction.** Inlet and exhaust valves are positive sealing without presence of oil.

4 **Safety valve.** (Not visible.) Provides constant bleed-off at maximum pressure.

5 **Bi-metal cylinder head.** Transfers heat faster—shrink-fitted around cast iron cylinder.

6 **Blast cooled.** Low temperature operation assures higher efficiency, longer life.

7 **Combined aftercooler, pulsation chamber, moisture separator.** Assures cooler, drier air at uniform pressure.

B&G Compressor built into dry cleaning machine.

B&G Oil-less Compressors are available in a complete line of portable tank-mounted and tankless models. Send for catalog GO-1156.

Oil-less AIR COMPRESSORS

BELL & GOSSETT COMPANY
Dept. FL-66, Morton Grove, Illinois

CIRCLE 20 ON TIME-SAVER CARD

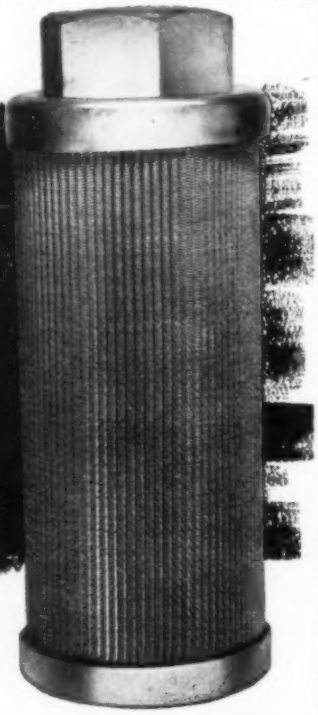
POST SCRIPTS OF INDUSTRY

In order to improve service and reduce costs, **Flexonics Corp.,** Maywood, Ill., will open offices in Detroit to house the headquarters of its automotive division and its central regional sales office. At the same time the company will cease its manufacturing operations at the Inkster, Mich., division and close the plant there. Production of products at Inkster will be transferred to other Flexonics plants. Full customer and service facilities will be maintained at the Detroit office under general manager **J. W. Wood** of the Automotive division and regional manager **R. G. Arnold.**

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

CIRCLE 26 ON TIME-SAVER CARD

S-P Manufacturing Corporation, Solon, Ohio, opened a new branch office in Detroit, located at 16301 Wyoming Ave. **John J. Scherer** has been appointed district sales manager and will head this new office. He will be assisted by **James C. Sprague.** The new office will offer complete sales and engineering service.

John J. Scherer
S-P Mfg. Corp.

Paul D. Kelly
Sterling, Inc.

Sterling, Inc., Milwaukee, named **Paul D. Kelly** to the position of assistant sales manager. Kelly's activities will concern themselves with closer and more frequent cooperation between the company and its sales representatives in matters of sales and engineering services.

As part of their planned expansion of engineering facilities and services, **Purolator Products, Inc.,** Rahway, N. J. made two new appointments. **Frederick R. Gruner,** chief engineer, has been given responsibility for all engineering activities as director of engineering. **Howard M. Gammon,** executive assistant to the president, has been appointed chief engineer in charge of all engineering activities at the Rahway plant.

F. R. Gruner
Purolator Products, Inc.

H. M. Gammon
Purolator Products, Inc.

A. E. Carter was elected vice president of manufacturing of **Worthington Corp.** Carter succeeds **Leslie C. Ricketts** who will now devote full time to increased responsibilities as group vice president of five Worthington operating divisions.

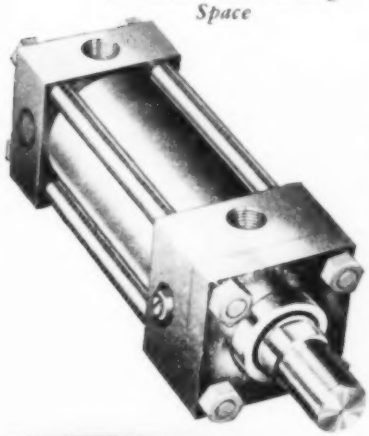
Bingham A. McClellan was promoted by the **Aeroquip Corp.**, Jackson, Mich., to sales engineer in charge of industrial

B. A. McClellan
Aeroquip Corp.

original equipment accounts in the Cleveland area. McClellan has been associated with Aeroquip since 1955.

Continued on next page

Maximum Working Force in Minimum Working Space



Milwaukee
Air or Hydraulic
CYLINDERS

- **Quality Construction Throughout**
- **No Costly Down Time**
- **Guaranteed Top Performance**
- **Precision Designed -Heavy Duty Service**
- **Conforms to JIC Specifications**

Get all the facts and see how Milwaukee Cylinders save space and weight . . . Save on original cost and save on maintenance.

Write today for Free Bulletins A-100 and H-100.

Standard Models
Hydraulic Bore Size 1½ to 12"
Air Bore Size 1½ to 14"
Specials built to your specifications

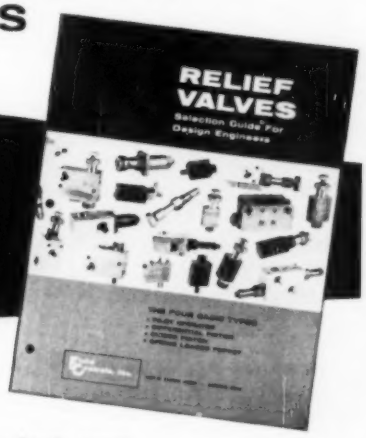
MILWAUKEE CYLINDER CO.
Division of L. & M. Machine Company

5735 So. Pennsylvania Ave., Cudahy, Wis.

CIRCLE 142 ON TIME-SAVER CARD

CIRCLE 51 ON TIME-SAVER CARD

Simplifies and helps assure proper selection of RELIEF VALVES



***NEW*, Free Selection Guide For Design Engineers**

Lists factors to consider when specifying, the advantages and limitations of each valve and engineering drawings of the four basic types.

- **Pilot-Operated**
- **Guided Piston**
- **Differential Piston**
- **Spring-loaded Poppet**

Manufacturer of the industry's most complete line of hydraulic relief valves.

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices

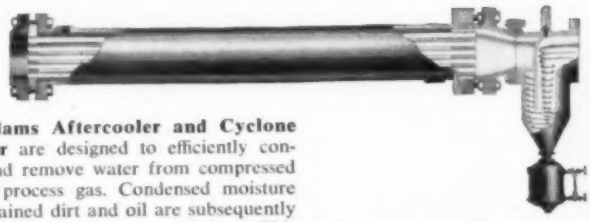
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER ST. • MENTOR, OHIO • BL 5-2625

Member of National Fluid Power Association

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
249 East Park Drive, Buffalo 17, New York



The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

CIRCLE 2 ON TIME-SAVER CARD

POST SCRIPTS OF INDUSTRY

Parker Hannifin Corp., Cleveland, Ohio, announced these appointments: **Railway & Power Engineering Corp.,** Ltd., with branches throughout Canada, as a franchised distributor of industrial hose assemblies and reusable hose fittings; **Atlas Engineering Co.,** Englewood, Colorado—franchised distributor for hose assemblies and reusable fittings; **Pacific Industrial Supplies, Ltd.,** Vancouver, B. C., Canada, distributor for hydraulic piston-type accumulators. Assignment of **C. Q. Hagerty** as district manager of distributor sales in sourthern California. Appointment of **Donald T. McDowell** as sales engineer in the St. Louis territory for synthetic rubber o-rings and other products of Parker Seal Co., a division of Parker Hannifin. **Robert B. Porter Co.,** Hayward, California as distributor of hose fittings and accumulators.

Hydreco Division, New York Air Brake Co., Kalamazoo, appointed **Howard F. Wilbern** as sales engineer in the Chicago area. Wilbern will cover the territory handled by **Robert Carpenter,** who was promoted to supervisor of mobile sales for the division.

H. F. Wilbern
Hydreco Division

Duane R. Branaka
Valvair Corp.

To supervise sales of the **Valvair Corporation's** products, **Duane R. Branaka** has been named sales manager. Branaka, a graduate engineer, has had previous sales experience in the Detroit and Chicago area.

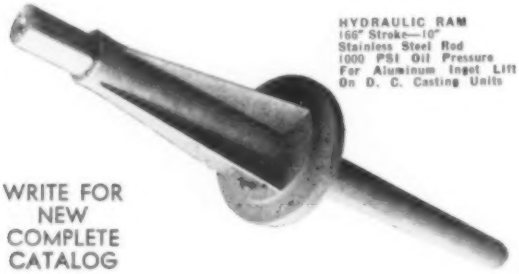
Automatic Switch Company, Florham Park, New Jersey, appointed these authorized stocking distributors: **The Martin Electric Co.,** Dayton 2, Ohio; **MG Electrical Equipment Co.,** Birmingham 3, Alabama; **Mills & Lupton Supply Co.,** Chattanooga, Tennessee; and **Ives Equipment Corp.,** Narberth, Pennsylvania.

Stein Atkinson, Vickers Hydraulics Ltd. announced the opening of a new office in London, located at 197 Knightsbridge, London, S.W. 7.

Installation of new plant facilities in Dallas, Texas, has been announced by **Aeroquip Corp.** The company formerly had a warehouse for servicing industrial customers. The new plant will serve both industrial and aircraft markets. Manager of the Dallas plant is **Clyde Stratton. Roger Leuba,** formerly of the engineering department at the Jackson, Mich., plant, will direct the aircraft operations.

Lincoln AIR AND HYDRAULIC Cylinders

The answer to the increased demand for rugged, heavy duty air and hydraulic cylinders. Designed for the hardest usage in Steel Mill operation or for the hundreds of other modern cylinder applications that require dependable efficient service.



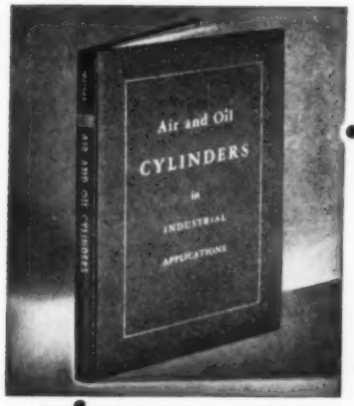
WRITE FOR NEW COMPLETE CATALOG

Lincoln
MACHINE CO. INC.

P. O. Box 272 EDgewood 2-4689 Salem, Ohio

CIRCLE 82 ON TIME-SAVER CARD

CIRCLE 141 ON TIME-SAVER CARD



AIR & OIL CYLINDERS

Elmer Heiser has written this valuable cylinder handbook which tells about types, cushions, how to order, proper porting, correct sizing, packings, and efficient installation methods.

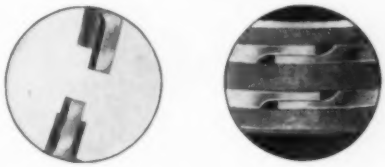
It's full of application ideas.

PRICE $5.00

The Industrial Publishing Corporation

812 Huron Road • Cleveland 15, Ohio

METALLIC LEAKPROOF SEAL



PERMASEAL piston rings enable you to seal against high temperature, unlimited pressure and the entire range of fluids and gases. The low initial cost and long service life of **PERMASEAL** combine to make the ideal seal for your applications.

Write for Engineering Data and Sample Ring

grover piston ring co.

120 N. BROADWAY, MILWAUKEE 2, WIS.

Rings manufactured to customer's specifications
STOCK SIZES: 1⅜" through 10" O.D.

write for NEW FREE CATALOG

of Kendall— Governaire precision pneumatic

PRESSURE REGULATORS for Industry

The facts you need on a complete range of pneumatic pressure regulating valves and volume boosters. Here is your guide to a series of pilot-operated and direct acting regulators—in pipe sizes from ¼ to ⅜ and ¾ NPT...in supply pressures up to 250 psi. Fact-filled pages spell out the full story: characteristics • pressure ranges, ratios • applications—for 16 different models including motor operated and lever set types.

Write today for the new KENDALL- GOVERNAIRE catalog.

STRATOS

INDUSTRIAL PRODUCTS BRANCH

Route 109, West Babylon, N. Y.

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION

Turbo-Expanders and Compressors
SPECON Variable Speed Drives and Transmissions
Pneumatic Pressure Regulators

CIRCLE 143 ON TIME-SAVER CARD

free catalog

WRITE BEFORE NEXT TUESDAY

47-page catalog illustrating complete line of

AIR CYLINDERS, AIR VALVES, AIR CLAMPS, DIAL FEED TABLES

ALLEN AIR

The cylinder of "distinction" shown above is a Factory Reject. Only straight rods available.

THE A. K. ALLEN CO. AH-10
225 East 2nd Street, Mineola, N. Y.
Name .....
Company .....
Address .....
City ..... Zone .... State .....

CIRCLE 10 ON TIME-SAVER CARD

AIRCRAFT
Hydraulic Engineers!
Keep Your Eye On WALDORF
(or better yet, why not join us?)

Waldorf is the military products division of F. C. Huyck and Sons, a well known manufacturer of special engineered products for the paper industry.

We manufacture a line of fluid control devices for aircraft.

Occupying a new, fully air conditioned 65,000 square foot plant in Huntington, Long Island, Waldorf has the latest in precision manufacturing and quality control equipment.

In joining Waldorf you have the advantage of working in a small but growing organization where you will be recognized for **your individual** efforts, yet you have the additional advantage of having behind you the resources of a larger and rapidly growing industrial supplier with over eighty years of proven performance.

If you have the kind of experience which you feel qualifies you to become a member of our team, please write Walter S. White, Personnel Director, Waldorf Instrument Company, Huntington Station, L.I.

Candidates will be invited (expense paid) to our facility, and if the mutual decision is made that you will join us, you and your family will be relocated at our expense.

Incidentally, we are sure you will find our salary, bonus, and benefit arrangements attractive.

waldorf *fluid* SYSTEMS

■ Waldorf Instrument Co., Huntington Sta., N. Y.
■ A Division of F. C. Huyck & Sons, Inc.

MARKET PLACE

AVAILABLE

Desire responsible position in sales project work. Experienced in applications and sales of fluid power equipment to user and O.E.M. accounts, pumps, valves, cylinders. Write to Box 10158, APPLIED HYDRAULICS & PNEUMATICS.

LINES WANTED

Northern California Hydraulic Sales, Service, Repair and Fabrication organization interested in securing quality hydraulic and allied lines to distribute. Write to Box 10258, APPLIED HYDRAULICS & PNEUMATICS.

WHERE OH WHERE—

can a frustrated Personnel Director find more engineers who consider their work a career, not a job; who will toil all hours to see their projects through; who put *ingenuity, quality* and *effort* ahead of all else; who are thirsting for the opportunity to grow in professional stature; who are anxious to be judged and compensated on their *own merit*, but are not afraid of being measured against the men of outstanding ability now on our team?

We are located in the Northeast, manufacturing a line of aircraft fluid controls and have entered an era of dynamic growth.

We have openings for engineers who are experienced in design and development of aircraft fluid controls (hydraulic or pneumatic).

We also have opportunities for recent grads who have that rare "spark" and promise.

Won't you write us? All inquiries will be courteously handled.

(This is not your company running this ad—we have shown a copy of it to our engineering staff).

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(Aircraft Fluid System Components)

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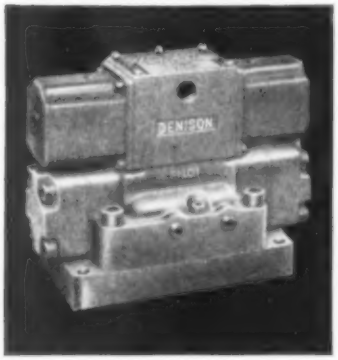
New pilot-operated, solenoid controlled

4-WAY VALVE

for shockless hydraulic control



Pilot-operated solenoid-controlled 4-Way Valve . . . for hydraulic systems to 3000 psi. Meets all JIC requirements. Shortest over-all length. Short, powerful solenoid stroke. Internal cords retain solenoid covers—no bulky external chains. Direct current and oil-enclosed solenoids available. Interchangeable parts. Special built-in check for pilot pressure available. Subplate or threaded body. Write for full details in Bulletin 240. Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

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If your equipment or process requires . . .

ACCURATE, AUTOMATIC TEMPERATURE CONTROL

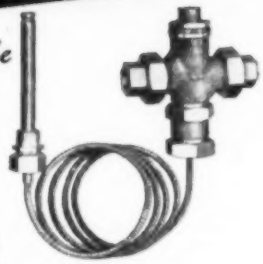
for HEATING or COOLING (using STEAM, WATER, or HEAT TRANSFER FLUIDS)

There is no equal to the

Sterlco®

Series 150-E

TEMPERATURE CONTROL VALVE



Here is a quality, dependable, and low cost self-actuated automatic modulating control valve. It's compact, self-contained; and, as part of your equipment or process, will eliminate the human factor of manual valves. Balanced single-seated construction eliminates effect of pressure variation. Send for Bulletin #505.

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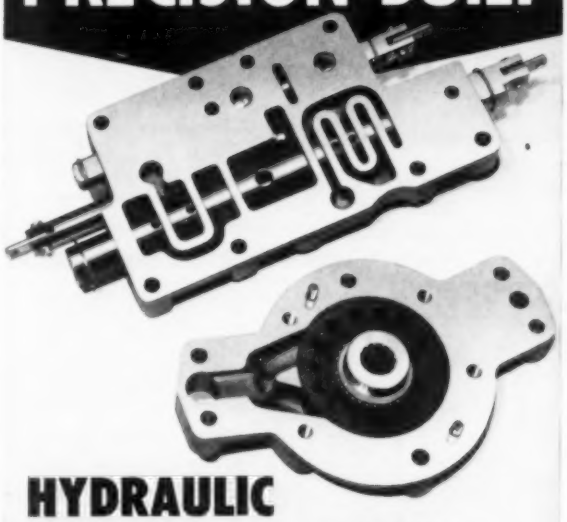

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to YOUR specifications

Over twenty years of specialized hydraulic valve and pump experience — newly enlarged, modernly equipped manufacturing facilities — an outstanding staff of thoroughly experienced craftsmen and an imposing list of satisfied customers is the best recommendation we can think of that you too will like our work.

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Why not invest a few minutes to hear the advantages of our service. It might well save you money and headaches.

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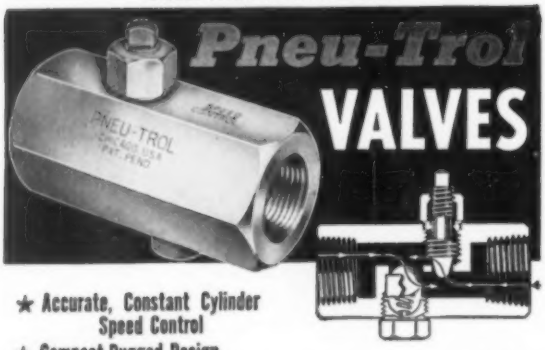
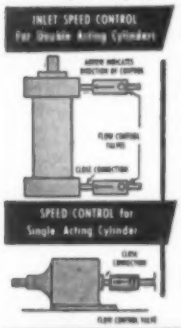
CIRCLE 98 ON TIME-SAVER CARD



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves, are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

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Write for illustrated circular and prices.

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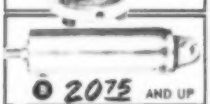
7424 N. KEATING AVENUE • CHICAGO 31, ILL



WORLD'S LARGEST ON-THE-SHELF STOCK OF HYDRAULICS

NEW PALLEY HYDRAULIC CYLINDERS –
Here are two of our newly developed line of double action Industrial Hydraulic Cylinders. These cylinders are designed to meet the most rigid requirements of industry. All are heavy duty steel construction.

Type (A) is a heavy duty, press type cylinder with bores of 3", 5", 6" and 8" – thrust range up to 75 TONS at 3000 PSI.

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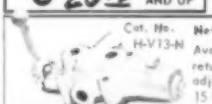
For complete listing of our tremendous stocks and prices – Send for our Special 396 Page Catalog TODAY



Cat. No. H-V13-N
Newly Developed 4-WAY, SLIDING PISTON VALVE
Available in open or closed center types, with spring return or detents. Has built-in relief valve which is adjustable from 1200 to 3100 PSI. Allows flow up to 15 GPM at 3000 PSI. Only . . . $32.75

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Motor designed to face mount any Aircraft type hydraulic pump. For continuous duty with high starting torque. 115/230 V, 220/440 V, 1 and 3 phase, 60 cycle AC. Sizes from 3/4 to 15 HP. Pressure up to 3000 PSI. Further information in catalog below.

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*Used but excellent condition.

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HYDRAULIC TEST STANDS – Available now at remarkable savings. Write for info.

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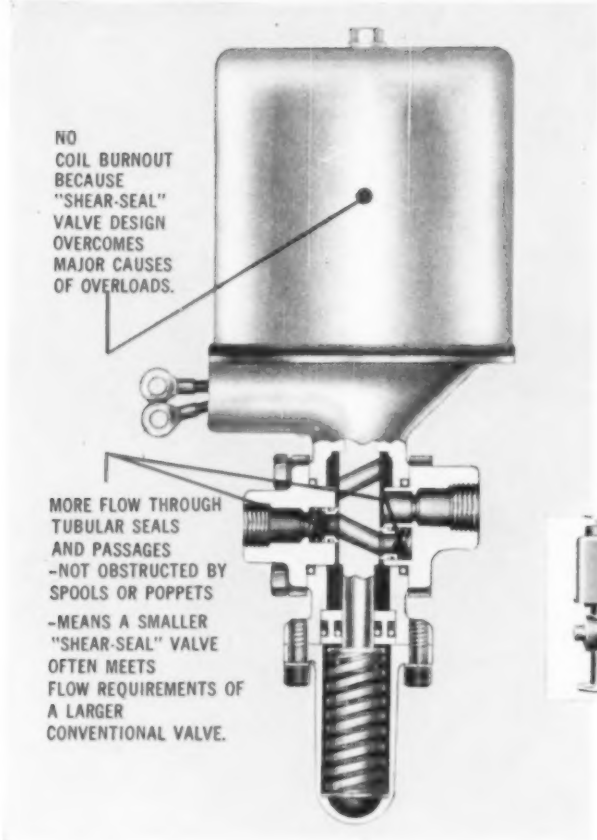
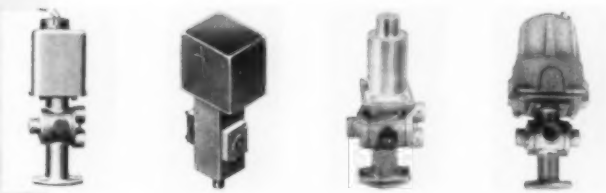
LEAKPROOF at 3000 P.S.I.

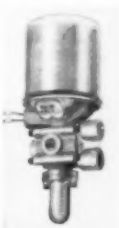
stop creeping cylinders!



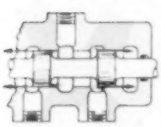
STANDARD WHEREVER CLOSE LEAKAGE SPECIFICATIONS ARE VITAL: On hydraulic clamps of paper cutters, in propeller pitch control for ships, to lift rollers over seams in textile printing, in rocket charging, in nitrogen and freon charging (refrigeration coils, pressure bottle charging of insecticides and shave cream), as high pressure cut in on presses, on soaking pit doors and lift tables in steel mills, for airblast control on copper converters, on oil well blowout preventers, in test board applications, wherever a valve must be leakproof and stay leakproof.



250 P.S.I., 1000 P.S.I. and 1500 P.S.I. Air Valves; 250 P.S.I., 1500 P.S.I. and 3000 P.S.I. Oil and Water Valves; for A.C. and D.C. operation, Standard and Explosion-proof; Shut-off, Three-way, Four-way and diverter flow patterns.



This is why we don't use



SPOOL VALVE DESIGN

They depend on leakage for lubrication, dirt can enter spool clearance, cause binding and coil burnout.

NO STICKING

because the movement of the sealing members does not depend on lubrication, the direct acting solenoid maintains a positive power margin.

LONG, MAINTENANCE-FREE SERVICE

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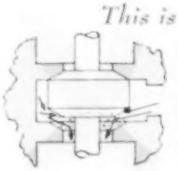

POPPET VALVE DESIGN

Dirt in fluid passes over sealing surfaces, acts like a sand blast quickly destroying sealing qualities.

Write for Catalog 58-59

barksdale valves CONTROL VALVE DIVISION

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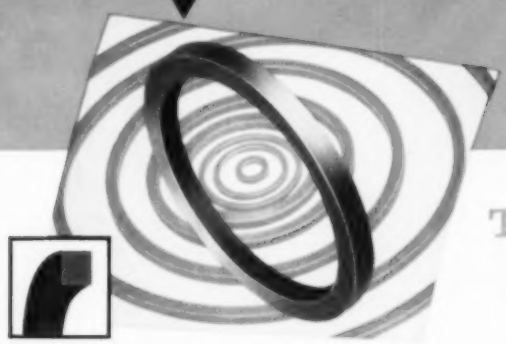
3 good reasons why you should

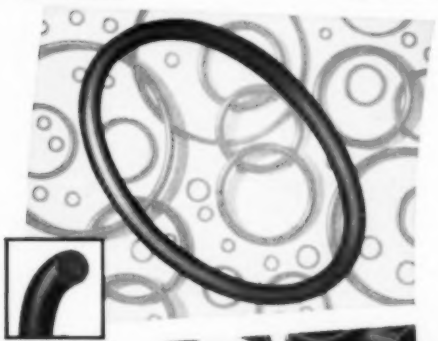
Go Goshen

. . . for new standards of precision and performance



TETRASEALS . . .

A Goshen Rubber exclusive, TETRASEALS are rectangular section rings that give high performance, economical sealing for most static and some dynamic applications. Made to extremely fine tolerance, from natural, synthetic and silicone rubber compounds, they're interchangeable with standard O-rings, use the same groove, require no special tooling and possess a homogeneous structure (non-laminated).



O-RINGS . . .

For O-rings that perform under today's greater temperature ranges, higher pressures and other severe conditions . . . Go Goshen. GRC O-rings are available in a complete range of AN, MS, SAE and JIC standard sizes, plus many non-standard sizes and special shapes . . . precisely molded from especially compounded natural, synthetic and silicone rubbers.

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In addition to critical seals, Goshen also precision-fabricates a wide range of parts and components from natural, synthetic and silicone rubber compounds. These parts such as bellows, bushings, diaphragms, gaskets, grommets, packings, and others, are not stocked, but produced promptly on order. Strictest requirements are met as to compound, service life and operating satisfaction.

COMPOUND FORMULATION

The exact combination of properties required in *your* seal or rubber part is assured by technicians in modern laboratories . . . developing compounds, experimenting and testing constantly for solution of customer problems.

send for literature . . . .

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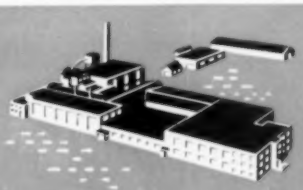
- ☐ O-RINGS
- ☐ GORLUBE (Low friction treatment)
- ☐ GOSHEN'S CUSTOM FACILITIES



Goshen Rubber Co., INC.

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